

Husbandry Guidelines

Polar Bear

Ursus maritimus



FIGURE 1. SOURCE: AZA BEAR TAG, 2009

Author: Kate Hannigan

Date of preparation: 23rd July, 2017

Open Colleges,

Course name and number: ACM30310 Certificate III in Captive Animals

Trainer: Allira May Mathe, Melissa Van Der Boom, Cassandra Rowe, Jacqui Brumm & Chris Hosking

Cover Photo Credit: Association of Zoos and Aquariums

Author contact details

Email: kate_hannigan94@hotmail.com

Disclaimer

Please note that these husbandry guidelines are student material, created as part of student assessment for Open Colleges ACM30310 Certificate III in Captive Animals. While care has been taken by students to compile accurate and complete material at the time of creation, all information contained should be interpreted with care. No responsibility is assumed for any loss or damage resulting from using these guidelines. Husbandry guidelines are evolving documents that need to be updated regularly as more information becomes available and industry knowledge about animal welfare and care is extended.

Workplace Health and Safety risks warning

Polar bears are large, powerful animals that pose a potentially serious risk to other animals and humans within zoos and aquariums. A polar bear exhibit must have all areas secure, and particular attention must be given to shift doors, gates, keepers access doors, locking mechanisms, and exhibit barrier dimensions and construction. “Buildings, exhibits, and grounds must be structurally sound and maintained in good repair, protecting the animals and keepers from injury” (AZA Bear TAG, 2009, p. 15). Guardrails/barriers must be constructed in all areas where the visiting public could have contact with other than handleable animals. Zoos and aquariums housing polar bears must have appropriate procedures in place that prevent the animal from escaping and injury to visitors/staff, as well as to prevent attacks and injuries. Regarding the health of the polar bear and any indications of disease, injury, or stress that need to be dealt with promptly, veterinary coverage must be available to the animal collection 24 hours a day, 7 days a week (AZA Bear TAG, 2009). In cases where the delivery of drugs is required there should be written, formal procedures available to animal care staff to allow them to correctly use animal drugs for veterinary purposes, the security of these drugs must always be provided. All Zoos and Aquariums must have separate holding facilities for quarantine of newly arrived bears and isolation facilities or procedures for the treatment of sick/injured animals. It is also vital to provide proper training and procedures put in place regarding zoonotic diseases (AZA Bear TAG, 2009).

Contents

Author contact details.....	1
Disclaimer.....	1
Workplace Health and Safety risks warning	2
1. Introduction	7
2. Taxonomy.....	8
2.1 Nomenclature.....	8
2.2 Subspecies.....	8
2.3 Other common names.....	8
3. Natural history.....	8
3.1 Morphometrics.....	8
3.1.1 <i>Mass and basic body measurements</i>	8
3.1.2 <i>Distinguishing features</i>	8
3.2 Distribution and habitat	8
3.3 Conservation status.....	9
3.4 Longevity	9
3.4.1 <i>In the wild compared to captivity</i>	9
4.1 Exhibit/enclosure design	9
4.2 Holding area design	9
4.3 Spatial requirements	100
4.4 Position of enclosures	100
4.5 Weather protection.....	100
4.6 Temperature requirements	100
4.7 Substrate	100
4.8 Nesting area/or bedding material	11
4.9 Enclosure furnishings	11
5. General husbandry	111
5.1 Hygiene and cleaning	111
5.2 Record keeping.....	111
5.3 Methods of identification	121
6. Feeding requirements	122
6.1 Digestive Tract and Morphology	122

6.2 Diet in the wild	122
6.3 Normal and Abnormal Feeding Behaviours in Captivity	122
6.4 Nutritional Requirements	132
6.5 Safe Food Items.....	13
6.6 Problematic Foods.....	13
6.7 Suitable Food and Supplements	13
6.8 Example Diet Plan.....	13
7. Handling and transport	177
7.1 Natural History	177
7.1.1 Behaviour under capture	207
7.1.2 Previous capture procedures	207
7.2 Welfare requirements	177
7.3 Timing of capture and handling.....	177
7.4 Equipment.....	187
7.5 Capture and restraint techniques/Example plan.....	197
7.5.1 Keeper and Veterinarian requirements.....	197
7.5.2 Capture	208
7.5.3 Restraint procedure	208
7.5.4 Alternative Actions	208
7.6 Emergency Procedures.....	199
7.6.1 Steps taken in case injury to staff	209
7.6.2 Steps taken in case animal escapes	209
7.7 Transport requirements	199
7.7.1 Box design	209
7.7.2 Furnishings	20
7.7.3 Water and food	20
7.7.4 Animals per box	20
7.7.5 Timing of transport.....	20
7.7.6 Release from box	21
7.7.7 Capture and Restraint Regulations	21
8. Health requirements	21
8.1 Daily health checks.....	21
8.2 Detailed physical examination.....	22
8.2.1 Chemical restraint	22
8.2.2 Physical examination	22
8.3 Routine treatments	22

8.4 Known health problems	23
8.4.1 Bacterial diseases	23
8.4.2 Fungal disease	24
8.4.3 Protozoa diseases	25
8.4.4 Viral diseases	25
8.4.5 Nutritional diseases	25
8.4.6 Parasitic infections	26
8.4.7 Endoparasites	27
8.4.8 Ectoparasites	28
8.5 Quarantine requirements	28
8.5.1 Zoonotic diseases and quarantine	28
8.5.2 Quarantine duration	29
8.5.3 Quarantine protocols	29
8.5.4 Quarantine examinations	29
8.5.5 Necropsy	29
9. Behaviour	30
9.1 Activity	30
9.2 Social behaviour	30
9.3 Bathing	30
9.4 Behavioural problems and signs of stress	30
9.5 Behavioural enrichment	31
9.6 Introductions and removals	33
9.7 Intraspecific compatibility	34
9.8 Interspecific compatibility	34
9.9 Suitability to captivity	34
10. Breeding	35
10.1 Wild and Captive Breeding Behaviours	35
10.1.1 Wild Behaviours	35
10.1.2 Captive Behaviours	35
10.2 Conservation Status and Previous Success of Breeding in Captivity	35
10.3 Reproductive Anatomical Structures and Physiological Features	35
10.4 Techniques used to control breeding	36
10.5 Courtship	36
10.6 Onset of breeding	36
10.7 Mating/Copulation	36
10.8 Facilitating Mating	37

10.9 Artificial Insemination	37
10.10 Nesting, hollow or other requirements	37
10.11 Breeding diet	38
10.12 Oestrous cycle and gestation period	38
10.13 Age at weaning.....	38
10.14 Age of removal from parents.....	38
10.15 Monitoring Processes and Records	38
10.16 Emergency Procedures/WHS Considerations.....	39
11. Artificial rearing.....	39
11.1 Background.....	39
11.2 Housing.....	39
11.3 Temperature requirements.....	39
11.4 Diet and feeding routine	40
11.4.1 Feeding and Intake	40
11.4.2 Elimination.....	40
11.4.3 Feeding Position	40
11.5 Specific requirements.....	41
11.6 Data recording.....	41
11.7 Hygiene.....	41
11.8 Behavioural considerations	41
11.9 Use of foster species	41
11.10 Weaning	41
11.11 Rehabilitation and release procedures.....	42
12. Acknowledgements	43
13. References.....	44
14. Bibliography	48
15. Glossary.....	49
16. Appendix	50

1. Introduction

Classification	Taxonomy
Kingdom	Animalia
Phylum	Chordata
Class	Mammalia
Order	Carnivora
Family	Ursidae

FIGURE 2. TAXONOMIC INFORMATION OF THE POLAR BEAR. SOURCE: AZA BEAR TAG, 2009

The Polar bear *Ursus maritimus* is the largest land carnivore of the world (Defenders of Wildlife, 2017), and the most carnivorous of the Ursidae family, with their prey being primarily ringed seals. When polar bears were first brought into captivity zoos and aquariums had difficulties maintaining their nutritional and mental health requirements. Due to obvious lack of information extensive research has been done and captive polar bear diets are now based on nutrients that would be received in the wild, a combination of (dry, raw, and/or gel), saltwater fish, bones, whole prey, produce, and enrichment food items (Polar Bear International Guidelines, 2006). Wild or *in situ* populations of polar bears are generally solitary, and no long term, social interactions between adults have been recorded, however social tolerance increases when interactions are depended on resource rich environments (AZA Bear TAG, 2009). The World Conservation Union (IUCN) estimates that there is now between 20,000-25,000 polar bears left in the world and has them listed as Vulnerable on the ICUN Red List (Defenders of Wildlife, 2017). Being the apex land predators of the Arctic they are often utilised as indicators and signs for issues with the arctic marine system (Defenders of Wildlife, 2017); Some of the greatest threats to Polar bears includes climate change, oil spills/oil exploration, toxic pollution, and over hunting (Defenders of Wildlife, 2017; WWF, 2017). Although, thanks to Zoos and Aquariums and their use of educating and inspiring public to take action on climate change, provide home for orphaned cubs, taking part in research, and helping to develop youth programs for the futures conservation advocates the wild Polar bears of today have a chance of survival (Polar Bears International, 2017).



FIGURE 3. SOURCE: POLAR BEARS INTERNATIONAL, 2017

2. Taxonomy

2.1 Nomenclature

Polar bears, whose scientific name is *Ursus maritimus* which in Latin means sea bear, taxonomically are a part of the Order Carnivora, and the Family Ursidae; Ursids are considered the largest terrestrial carnivores (Seaworld Parks and Entertainment, 2016).

2.2 Subspecies

Ursidae family is divided into three subfamilies which includes Ursinae (Black Bears, Brown Bears, Polar Bears, Sun Bears, and Sloth Bears), Tremarctinae (Spectacled Bears), and Ailuropodinae (Giant Pandas) (Seaworld Parks & Entertainment, 2016).

2.3 Other common names

Some of the other names that Polar Bears are called include Ice Bear, White Bear, White Sea Deer, and Old man in the fur coat (Polarbears International, 2016).

3. Natural history

3.1 Morphometrics

3.1.1 *Mass and basic body measurements*

The average weight of polar bears include the following: Males (Boars) 350-650kg and are 2.5-3m in length; Females (Sows) weigh 150-295kg and are 1.8-2.5m in length; Pregnant females can weigh up to 500kg in weight; and Young (cubs) are half kilogram at birth (Live Science, 2014; SeaWorld, 2017).

3.1.2 *Distinguishing features*

Polar bears, depending on the light, have pure white to yellow to light brown coats. A polar bear's thick, woolly coat contains an insulating layer of under hair that is covered with a stiff layer of shiny, hollow guard hairs. With the fur also being oily and the skin being black in colour, the Polar bear is gifted with water resistance and the ability to absorb sunlight energy to stay warm. Compared to their bear relatives Polar bears have much more slender bodies with longer necks and heads. Compared to the size of their body their paws are relatively large, measuring 30cm in diameter and acting like snowshoes, spreading out the bear's weight as it moves over the ice and snow (SeaWorld, 2017).



FIGURE 4. SOURCE: SEAWORLD, 2017

3.2 Distribution and habitat

Polar Bears are found inhabiting the Arctic Circle (Canada, Russia, Alaska, Greenland and Norway). Temperatures can range from -34 to -69°C; water temperatures are cold temperatures of -2°C (Live Science, 2014). Edges of pack ice is where polar bears are most likely to be found. These areas are where ocean currents and wind cause the ice to continually melt and refreeze creating a matrix of ice patches that make it easy for polar bears to hunt for food (Defenders of Wildlife, 2016).

3.3 Conservation status

Polar Bears are currently listed as vulnerable on the IUCN Red List (IUCN Red List, 2017).

3.4 Longevity

3.4.1 In the wild compared to captivity

A polar bears life span in the wild ranges from 15 to 20 years, compared to 30 to 40 years in captivity (Live science, 2014 & Polar Bears International, 2016)

4. Housing requirements

4.1 Exhibit/enclosure design

Polar bear exhibit designs should include topographical complexity and multiple pathways throughout the habitat to facilitate natural social avoidance behaviour. Polar Bears should have the ability to choose and gain access to off-exhibit areas, unless housed inside at night or when maintenance to the exhibit is undertaken. Polar Bears require a large exhibit where the habitat mimics that of the wild, so all sensors are stimulated (visual, olfactory, tactile, gustatory, and auditory) (AZA Bear TAG, 2009). See figure 5 for an elevated view of the Polar Bear Exhibit at Lincoln Park Zoo.

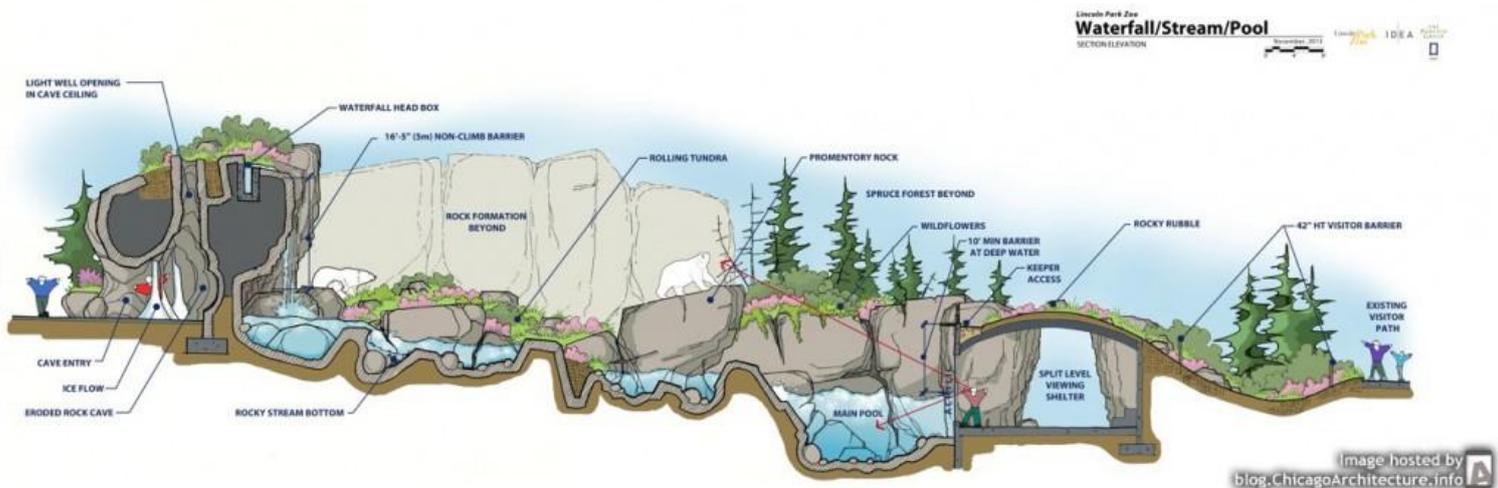


FIGURE 5. THE POLAR BEAR EXHIBIT AT LINCOLN PARK ZOO. SOURCE: CHICAGO ARCHITECTURE, 2017

4.2 Holding area design

The holding area may be made up of off-exhibit areas for the polar bears to escape from public eyes/other bears or an area where they sleep at night, and cubing dens. The off-exhibit areas should provide equal behavioural opportunities as the primary exhibit. The off-exhibit area should be at least 75m² (807 ft²), with an additional 25m² (269 ft²) for each additional bear within the habitat. Each bear should have its own area for sleeping or temporary holding/separations. Temporary holding areas must be at least 4m x 3m x 2.5m (13ft x 9.8ft x 8.2ft) (AZA Bear TAG, 2009). As the cubing den is specifically designed for pregnant females who must remain in the den throughout the winter. The den must be quiet and away from the exhibit, it may help to allow the female to pick which den she

would like as it has been known to increase the success of mother-rearing subs (AZA bear Tag, 2009). The Manitoba Polar Bear protection Act regulations state that cubing dens must be at least 2.5m x 2.5m x 2.5m (8.2ft x 8.2ft x 8.2ft) (PBPA, 2002).

4.3 Spatial requirements

The enclosure should be of a size that stimulates all of the bears' senses. Although it should be an appropriate size so that the bears are not over stimulated (AZA Bear TAG, 2009). It is stated by the Manitoba Standards that for 1 -2 bears must have access to 500m² of dry land, and an additional 150m² of land for each polar bear in the enclosure (AZA Bear TAG, 2009). It is important that there are off-exhibit areas for each polar bear so they may have their own area for sleeping and temporary holding (AZA Bear TAG, 2009). It is important that these areas encourage the same natural behavior as the main exhibit.

4.4 Position of enclosures

The ideal position would be a large outdoor exhibit that includes natural lighting that, shelter and the space that allows the polar bear to carry out natural behavioural instincts.

4.5 Weather protection

It is favoured that Polar bear exhibits are outside. This is because, "the frequency of air changes is not applicable" (AZA Bear TAG, 2009, p. 10). If a polar bear exhibit is indoors it must, "meet or exceed the federal standards" (AZA Bear TAG, 2009, p.10) that comply with air changes "in dog/cat/primate indoor facilities" (AZA Bear TAG, 2009, p. 10) that entail ventilation systems to decrease ammonia levels, drafts, odours, and moisture condensation (AZA Bear TAG, 2009). On a daily basis, all water quality tests must be completed and recorded. The access to potable, clean drinking water is a must at all times; and any additional chemicals in the water are not allowed to cause any discomfort or harm to the bear. Levels of Coliform bacteria in water must also be checked weekly on a weekly basis (AZA Bear TAG, 2009).

4.6 Temperature requirements

"There has been no scientific determination for minimum or maximum temperatures for polar bears care for in zoos and aquariums" (AZA Bear TAG, 2009, p.9). Temperatures of an arctic environment which in summer can reach temperatures of 26°C. Although it is unknown whether polar bears are able to thermoregulate with the changing environmental conditions. There for it is important that exhibits include furnishings that will provide the polar bear with cool, shaded areas to escape to when temperatures are high (AZA Bear TAG, 2009). Lighting should only be natural, this includes indoor areas which must have a sky light; this excludes cubing dens. Any indoor areas are required to have lighting that mimics natural light that is seen in, "the geographical area of the exhibit" (AZA Bear TAG, 2009, p.10).

4.7 Substrate

Suitable materials must include natural landscape to promote species-appropriate behaviour (AZA Bear TAG, 2009). Such materials can include foliage, boulders, trees, a pool, substrate

pits that are made up of various soft materials. There should be no off limited areas to the exhibit, the animal should be allowed choose where they want to go (AZA Bear TAG, 2009).

4.8 Nesting area and/or bedding material

Nesting areas are an important aspect to a polar bear exhibit. Nesting areas are a part of the off exhibit holding areas where the bears sleep at night. They must be made up of appropriate materials such as wool, mulch, bark chips, straw, or hay (AZA Bear TAG, 2009). The habitat should be made up of complex pathways and design to reduce stereotypical behaviour (AZA Bear TAG, 2009).

4.9 Enclosure furnishings

Because Polar bears are used to a cooler environment it is important that materials that create shade are placed around the enclosure. Materials or items that you could use to create shaded areas include trees, rocks, large branches, and shrubs (AZA Bear TAG, 2009). There should also be plenty of access to spaces which incorporate air conditioning, sprinklers and misters, ice piles, wind generating fans, and large pools that allow the bear to swim (AZA Bear TAG, 2009). If any of these features are unavailable, it is recommended that, “access to temperature regulated indoor holding areas” (AZA Bear TAG, 2009, p. 10) are available for full time use.

5. General husbandry

5.1 Hygiene and cleaning

If any personnel are in the habitat, polar bears must be shifted to off-exhibit areas, they must also be moved if chlorine or any other chemical is being used in the exhibit (AZA Bear TAG, 2009). Selected water quality parameters should be monitored so that confirmation that the right operation of disinfection and filtration of water supplied to animals is working appropriately (AZA Bear TAG, 2009). Any grass or dirt substrates must be spot cleaned daily, this also includes all washable surfaces, enrichment objects, logs, and food containers which must be disinfected with detergent on a regular basis (AZA Bear TAG, 2009). Any substrates such as bedding must either be washed or replaced. Any indoor areas must be provided with sufficient lighting so the animal caretakers may work safely within the exhibit (AZA Bear TAG, 2009).

5.2 Record keeping

Keeping records of animals is an important element in animal care, which ensures that information about individual animals and their treatment is always available to staff (AZA Bear TAG, 2009). “All pertinent health information for polar bears should be recorded as per institutional protocols in ARKS and MedARKS” (AZA Bear TAG, 2009, p.35). The Zoological Management System (ZIMS) is also a helpful recorded system which allows keepers to record and be provided with information on an individual animal’s health records, including data on the onset or elimination of stereotypical behaviour and responses to enrichment initiatives, conspecifics, or heterospecifics (AZA Bear TAG, 2009).

5.3 Methods of identification

To ensure that all Polar Bears can be easily identified each polar bear is given corresponding ID numbers. These numbers allow health data to be recorded about the individual animal throughout its life. Polar Bears can also be identified by the use of visual appearance, behaviour, microchip transponders or lip tattoos. Microchips are placed intramuscularly between the scapular of the polar bear, and allows other zoos and aquariums to track that microchip to minimise confusion if staff are changing within institutions (AZA Bear TAG, 2009).

6. Feeding requirements

6.1 Digestive Tract and Morphology

Polar Bears are carnivores, but have been known to occasionally eat some forms of vegetation (Live Science, 2014 & Polar Bears International, 2016).

They need to consume up to 2kg of fat a day which is equal to 55kg of seal.

The morphology of their stomach is simple. The cecum is absent and there is no obvious external similarities between the small and large intestines. In the wild Polar bears require 140-180 kcal/kg^{0.75} of metabolized energy, whilst in captivity, polar bears only consume 110ME/kg^{0.75} on a daily basis (Zutrition, 2013).

6.2 Diet in the wild

Adult polar bears mainly prey on seals. But have been known to eat vegetation, geese, bird eggs, small mammals and whale remains such as belugas (Polar Bears International, 2016).

Juveniles or subcubs whilst still feeding on their mother's milk generally still eat the same as adults. A polar bear cub's diet just consists of their mother's milk which made up of 36% fat (Polar Bears International, 2016).

6.3 Normal and Abnormal Feeding Behaviours in Captivity

Normal

"Periods of hyperplasia can occur during spring and summer" (Zutrition, 2013). During winter/spring bears will display negative foraging behaviour due to hibernation (Zutrition, 2013). Polar Bears in captivity have been known to eat less during spring and summer months, eating increases during autumn and winter months (Zutrition, 2013).

Abnormal

Stressed bears will show inconsistent feeding behaviours (Zoo Check). Constant stress can lead to bears constantly cleaning themselves, repetitively lapping their enclosure, self-mutilation, vomiting and regurgitating; bears have also been seen playing with or eating their own excrement (known as coprophillia and Copeophillia) (Born Free, 2016).

6.4 Nutrition Requirements

Captive bears require a balanced diet, a combination of nutritionally whole items (dry, raw, and/or gel), marine (saltwater) fish, whole prey, produce, and behavioural enrichment items

is required; pregnant females, and mothers with cubs/sub cubs require an increased protein consumption (Zutrition, 2013).

6.5 Safe Food Items

Enrichment/training: ie. Supplemental foods such as raisins, peanut butter or honey can be offered but should not exceed, “3% by weight of the total diet” (Zutrition,2013).

Other sources of enrichment may include items such as watermelons, pumpkins, apple sauce, eggs, cheerios, kelp, other seasonal fruits, cow hooves and ears (smoked or plain) and calf carcasses (Zutrition, 2013).

6.6 Problematic Food Items

Road Kill: food that is offered must always be fresh and uncontaminated. Road kill does not offer these qualities and can contain harmful diseases.

Sick animals: animals that have been sick and died should not be used as food. Especially animals that have been euthanized as the chemical used for euthanizing animals is extremely poisonous.

Animals that are showing signs of nervous system disorders: these animals pose a risk of transmissible spongi from encephalopathy's. Animals that pose this risk include: horses, dairy and beef cows, and other livestock. Also, any animals that may be suffering any chronic wasting disease (Zutrition, 2013).

6.7 Suitable Food and Supplements

Vitamin A: it plays a major role in the regulation of homeostasis. Dosage requirement includes a minimum of 5IU/g dry matter in the diet is recommended (Zutrition, 2013).

Vitamin E and Thiamin: Is offered if the bear is consuming greater than 30% of fish in their diet. A safe approach to supplementing the fish portion of the diet for vitamin E and thiamine is by supplementing 30mg thiamine and 100 IU vitamin E per kilogram of fish that the bear is offered (Zutrition, 2013).

6.8 Example Diet Plan

Polar Bear *Ursus maritimus*

Sex: Male

Average Weight: 432kg/ 952.4lb

Health Status: In good health

Important Notes:

Water – All water dishes should be disinfected and cleaned, and old water replaced with fresh on a daily basis.

Vitamin E and Thiamin – For polar bears that are consuming greater than 30% of fish 30 mg of thiamin and 100 IU of Vitamin E should be supplemented per kg fish offered (Zutirion, 2013).

Dry Food – is a nutritionally completed food that is premade, bears should be fed approximately 90.72kg/2 pounds per 45.36kg/100 pounds each day. This is should be fed

inside den via flip dishes/feeding tubes (Mazuri, 2016).

Raw Meat Mix – Raw meat mix can consist of the following; beef heart, chicken heart, chicken liver, ground beef bone, eggs, spices and herbs (ie. rosemary, basil, ginger), kelp, cheerio’s, seasonal fruits (ie. Grapes, blueberries); The meat mix is encouraged to be different for each meal.

Marine Products – fresh saltwater fish species. It’s important to not use the same species of fish continually as the bear may refuse to eat other species when offered. See figure 6 for criteria to assess the quality of raw fish.

Produce – includes any naturally sourced vegetables.

Behavioural Enrichment – May include the following: ice blocks containing food, pine cones, hard boiled eggs, whole pumpkins or watermelons, corn stalks, knuckle bones, bird feathers, freeze dried liver treats, peanuts, cow hooves and ears, smoked or plain (can be subtitled with pig). These items can be scattered around the enclosure, placed into food dishes or in barrels (Zutrition, 2013).

Whole Prey – Whole prey should be given within den via flip dishes/feeding tube. May include anything from large rats or rabbits, to half a carcass of a calf.

TABLE 1. AN EXAMPLE OF A WEEKLY CAPTIVE POLAR BEAR DIET

Day	Feeding plan
Sunday	<p>Morning Feed <u>Fed inside den:</u></p> <ul style="list-style-type: none"> • Dry Food 10% • Raw meat mix 65% <p><u>Fed in public enclosure:</u></p> <ul style="list-style-type: none"> • Marine Products 15% • Produce 5% • Behavioural Enrichment 3% <p>Afternoon Feed <u>Fed inside den:</u></p> <ul style="list-style-type: none"> • Whole Prey 2%
Monday	<p>Morning Feed <u>Fed inside den:</u></p> <ul style="list-style-type: none"> • Dry Food 21% • Raw meat mix 40% <p><u>Fed in public enclosure:</u></p> <ul style="list-style-type: none"> • Marine Products 30% • Produce 3.5% • Behavioural Enrichment 3% <p>Afternoon Feed <u>Fed inside den:</u></p> <ul style="list-style-type: none"> • Whole Prey 2.5%
Tuesday	<p>Morning Feed <u>Fed inside den:</u></p> <ul style="list-style-type: none"> • Dry Food 15% • Raw meat mix 60% <p><u>Fed in public enclosure:</u></p> <ul style="list-style-type: none"> • Marine Products 15% • Produce 10% • Behavioural Enrichment 0% <p>Afternoon Feed</p>

	<p><u>Fed inside den:</u></p> <ul style="list-style-type: none"> • Whole Prey 0%
Wednesday	<p>Morning Feed</p> <p><u>Fed inside den:</u></p> <ul style="list-style-type: none"> • Dry Food 17% • Raw meat mix 45% <p><u>Fed in public enclosure:</u></p> <ul style="list-style-type: none"> • Marine Products 25% • Produce 7.5% • Behavioural Enrichment 3% <p>Afternoon Feed</p> <p><u>Fed inside den:</u></p> <ul style="list-style-type: none"> • Whole Prey 2.5%
Thursday	<p>Morning Feed</p> <p><u>Fed inside den:</u></p> <ul style="list-style-type: none"> • Dry Food 50% • Raw meat mix 30% <p><u>Fed in public enclosure:</u></p> <ul style="list-style-type: none"> • Marine Products 15% • Produce 5% • Behavioural Enrichment 2% <p>Afternoon Feed</p> <p><u>Fed inside den:</u></p> <ul style="list-style-type: none"> • Whole Prey 1%
Friday	<p>Morning Feed</p> <p><u>Fed inside den:</u></p> <ul style="list-style-type: none"> • Dry Food 42% • Raw meat mix 30% <p><u>Fed in public enclosure:</u></p> <ul style="list-style-type: none"> • Marine Products 20% • Produce 5.5% • Behavioural Enrichment 0% <p>Afternoon Feed</p> <p><u>Fed inside den:</u></p> <ul style="list-style-type: none"> • Whole Prey 2.5%
Saturday	<p>Morning Feed</p> <p><u>Fed inside den:</u></p> <ul style="list-style-type: none"> • Dry Food 44% • Raw meat mix 35% <p><u>Fed in public enclosure:</u></p> <ul style="list-style-type: none"> • Marine Products 18% • Produce 10% • Behavioural Enrichment 3% <p>Afternoon Feed</p> <p><u>Fed inside den:</u></p> <ul style="list-style-type: none"> • Whole Prey 0%

Factor	Acceptable	Inferior	Unacceptable
General appearance	Shine or luster to skin; no breaks in skin, bloating or protrusion of viscera, no dehydration	Some loss of sheen	Luster gone, lumpy
Eyes	Translucent, full; may be slightly sunken	Dull or cloudy, slightly sunken	Dull, sunken; cornea opaque (white); red-bordered eyes
Gills	Bright red to pink; moist	Pink to slight brownish	Grayish-yellow and covered in mucus
Odor	Fresh odor	Mild sour or "fishy" odor	Medium to strong odor, fatty fish may smell rancid
Feel	Firm and elastic; meat does not stay indented when touched	Moderately soft, slight indentation left when touched	Soft, spongy and flabby; exudes juice and easily indented when handled; may break open or skin may split when handled
Vent	Normal in shape and color	Slight protrusion	Noticeable discoloration
Lateral line	Normal, no discoloration	Pinkish tinge	Red to dark red

FIGURE 6. CRITERIA FOR ASSESSING THE QUALITY OF FISH. SOURCE: ZUTRITION, 2013

7. Handling and transport

Polar Bears are large, potentially dangerous mammals so therefore careful consideration of handling must be given when capturing/restraining these animals for transport.

7.1 Natural History

7.1.1 Behaviour Under capture

Polar bears have been known to become easily stressed. Bears can become exhausted easily when in pursuit, if showing signs of fatigue the pursuit of the animals must be stopped as over exhaustion can lead to injury or death of the animal (Wildtrack, 2004)

7.1.2 Previous Capture Procedures

Remote drug delivery – immobilization by administration of aesthetic. Culvert – the bear is attracted by food (bait) into a large culvert or barrel that is open at one end, which is often mounted on a trailer.

7.2 Welfare requirements

Animal must be handled by a proficient keeper in a practical manner that decreases the stress of the animal. The animal must be monitored thoroughly by the senior zoo keeper and veterinarian throughout whole anaesthetised period. Equipment and facilities must be designed to prevent injury to the animal, in good working order, readily available to keeper and appropriate for the animal. Capture methods must be abandoned if animal becomes stressed, causing injury to itself and possibly others (staff, other animals). If pregnant the bear should not be captured within 4 weeks prior den entry (Environment and Natural Recourses, 2011). Capture efforts must be conducted within a temperature range, and procedures must be taken to prevent, detect and treat changes in body temperature during handling and recovery (Environment and Natural Recourses, 2011).

7.3 Timing of capture and handling

The timing and capture of the Polar Bear should occur in the early hours of the morning, before the zoo opens. Due to temperature restraints (especially in warmer seasons) with these animals it's important that the bear is captured while it is still cool, otherwise higher temperatures can create a stressful atmosphere for the bear (AZA Bear TAG, 2009).

7.4 Equipment

Because Polar bears are such large animals both capture and drug delivery equipment should be used. Capture and restrain equipment: Net, bags/sacks. Ropes, stretches, visual barriers, crush cages, and chutes. Drug delivery equipment: modified rifle, shotgun, blowpipe, and darts that contain the drug.

7.5 Capture and Restraint Techniques/Example Plan

7.5.1 Keeper and Veterinarian Requirements

Prior to chemical immobilisation the animal must be starved a minimum of 8 hours of both food and water. Keeping staff are responsible for the safety of the animal and staff until veterinary staff commence chemical immobilisation. Once immobilisation has begun the

veterinarian assumes responsibility. The veterinarian assess the level of sedation by checking the animal for response via a touch stimulus. Keepers must monitor the animal closely as it wakes up from sedation and assist veterinary staff as requested. Once veterinary staff are happy with anaesthetic recovery, keeping staff take over the place of monitoring the animal.

7.5.2 Capture

The immobilization of the animal through the use of administration of aesthetic drugs using one of the following delivery systems: modified rifle, shotgun, pistol, blowpipe, and darts that contain the drug. The dart needle length needs to be selected based on the size and body condition of the bear. The animal must be inside den when drug administration occurs to prevent injury to the animal. When entering the den a net must be placed over the bear, the bear should then be transferred via a stretcher with cargo net over the stretcher (Environment and Natural Resources, 2011).

7.5.3 Example Restraint procedure

The bear being restrained using chemical immobilisation, nets and stretchers.

Steps taken:

1. The bear is fed in the den in the morning. Previous training that has taught the bear to be comfortably feed alone within the den. During this procedure Senior Keeper is present, 5 keeping staff, 2 qualified fire arms officers and 1 vet.
2. Whilst the animal is fed the qualified fire arms officer uses a dart gun to administrate aesthetic drugs.
3. When the vet notifies keepers that it is safe to enter the enclosure. 5 keepers will enter the enclosure with the following equipment: stretcher, large and small hessian sack, net.
4. The 5 keepers carefully entre the den. They then move the polar bear onto the stretcher. A small hessian bag is placed over the bears head. And a larger bag and net is placed over the rest of the body. All keepers the remove the bear on the stretcher and taken to the vet via carefully loading the stretcher into the back of a truck that will transport the bear to the onsite vet.

Fire arms officers and 5 keeping staff plus senior keeper must be present during the whole capture and restraint procedure (this includes transporting to and from vets) to ensure everything runs smoothly.

7.5.3 Alternative Actions

If the bear starts becoming stressed, causing injury to itself, other animals or the keepers the procedure must be aborted. If temperature is a factor in stress, actions must be taken to lower the body temperature of the bear. If the bear is becoming a threat to keepers, or has escaped and is now a threat to not only keepers but people visiting the zoo, then a qualified firearms officer will come into play – either anesthetising or killing the animal.

7.6 Emergency Procedures

7.6.1 Steps taken in case injury to staff

1. The staff must be separate from the bear throughout the sedation process and must know all safety exists within and outside of the enclosure.
2. Two fire arms officers must be present throughout entire procedure.
3. If Bear begins to wake up and become stressed/aggressive staff must evacuate the area. The fire arms officers would then step in.
4. If the animal was inside the enclosure steps to sedate the animal again could be taken using a blow dart gun or modifies refile. Although if the lives of keepers are being threatened the animal would have to be shot and killed.
5. If a keeper is injured, the animal must be shot and the other keepers would have to safely enter the enclosure and remove the injured keeper.
6. If injury is severe an ambulance must be called and an incident report would have to be completed and reported to management.

7.6.2 Steps taken in case animal escapes

1. All Zoo staff must be notified immediately, and public should begin to be removed from the zoo in a calm, fast approach.
All public and staff members must move to safer areas.
2. Fire arms officers should be notified immediately, prepared to shoot or sedate the animal.
3. The situation must be observed by senior keeper and a decision must be made based on behaviour of the bear and safety of the public whether the bear can be sedated without causing any harm to the bear or the public.
4. If public or keeping staff lives become threatened the bear must be shot and killed immediately.
5. If anyone is severely injured triple 000 must be called and an incident report must be completed and incident must be reported to management.

If sedation of the bear is possible keeping staff must be prepared with correct equipment to remove safely capture and retrain the bear and safely transport it back to its enclosure from where it would then be monitored by keeping staff.

7.7 Transport requirements

7.7.1 Box design

Crates for transporting polar bears can be made out of hardwood, metal, aluminium, welded mesh, and/or iron bars. The transport box must provide adequate containment, life support, comfort, temperature control, food/water, and safety. The crate must meet the following requirements; see Appendix A, figures 22 and 23 for an example of Container Requirements: Frame: The frame should be made out of either solid wood or metal bolted/screwed together, with spacer bar 2.5cm deep along the side of air circulation. Due to the strength and size of the bear there should be additional metal reinforcing braces (AZA Bear TAG, 2009).

Doors: Sliding or guillotine exit doors must be provided; the front door must be made of

steel welded mesh, or strong iron bars placed in such a way that the animal cannot extend its legs between them. Both doors must be fastened with screws or bolts to prevent accidental opening (AZA Bear TAG, 2009).

Interior and exterior: The inside of the container must be completely lined with street iron or other hard metal sheeting, with ventilation openings punched through to the exterior. The front of the container must also be provided with a light sliding wooden shutter either with 10.2cm ventilation openings, or be slatted with 7cm spaced between the slats over the upper two thirds of the shutter, in order to reduce the disturbance to the animal and to protect handlers. Spacer bars or handles must be 2.5cm deep and formed from the framework of the container. The design of the crate and ventilation openings should include an access area for use by a pole syringe (AZA Bear TAG, 2009).

Ventilation: Ventilation openings must be placed at heights that will provide ventilation at all levels including when the animal lying down. Exterior mesh ventilation openings, with a minimum diameter of 2.5cm, must be open on all sides, entry door, and roof. USDA regulations require 20% of the total crate surface area to be ventilated (AZA Bear TAG, 2009).

Size: The height of the container must allow the animal to stand on all fours with its head extended; the length of the container must permit the animal to lie in the prone position. Polar bears should be able to turn around, although there must be at least 10.2cm clearance around the animal when standing in a normal position (AZA Bear TAG, 2009).

7.7.2 Furnishings

Straw can be used in the container for comfort and absorption of excreta, but plant material used must be acceptable to receiving countries. Although the floor of the crate should be in a narrow slatted form over a liquid proof tray, to provide a section for the faeces to fall into, or should be covered with absorbent material to prevent leaking of excreta (AZA Bear TAG, 2009).

7.7.3 Water and food

When the animal is at a suitable level of recovery from sedation (has control of movements), water should be offered in a suitable vessel. When traveling the bear can be given water within the 12 hours before departure, if the temperature is hot because of warmer seasons the water can be offered before departure.

7.7.4 Animals per box

Because of a Polar bears size and carnivorous nature bears need to be shipped individually (AZA Bear TAG, 2009).

7.7.5 Timing of transportation

Capture and restraint of a Polar Bear needs to be performed in early morning and late afternoon, especially in warmer months of the year. The bear should not be confined in a transport container for more than 2 hours prior or after transport. If the animal shows any signs of stress during the pursuit process of anaesthesia, the procedure must be aborted (Environment and Natural Resources, 2011).

7.7.6 Release from box

It is important that the crate be securely anchored before releasing the bear into the holding or quarantine area of the receiving institution. Release protocols should be well define and clear to all animal care staff prior to its occurrence (AZA Bear TAG, 2009).

7.7.7 Capture and Restraint Regulations

Polar Bears are internationally protected under the International Agreement on the Conservation of Polar Bears, which requires governments of all signing nations to manage Polar Bears according to ‘sound conservation practices’ (Environment and Natural Resources). When moving a Polar Bear from one zoo to another the following requirements must be met: a grant and export/import permit, a licence to export/import, Re-exportation requires a certificate granted by the Management of the State (Cites, 2013), if the animal is not covered by any other legislation a Balai (Council Directive 92/65/EEC) Application must be completed and submitted (GOV. UK, 2014), a veterinary health certificate which has been approved by a Defra-approved veterinarian is needed(GOV. UK, 2015), and for shipment all transport crates must meet both IATA (International Air Transport Association) guidelines and USDA regulations (AZA Bear TAG, 2009).

8. Health requirements

8.1 Daily health checks

Daily health checks on individual bears can be performed whilst the bear is in the holding area/night den. Keepers can perform trained medical behaviours such as “open mouth” for an oral exam, and “paw presents” to evaluate dorsal and ventral surfaces of the feet and nails. They can also take notes on the animals’ overall wellbeing, for example, is the animal eating, is there any unusual colouring to the fur, overall body condition (fig. 7), or faecal matter condition (solid or runny faeces) (AZA Bear TAG, 2009).

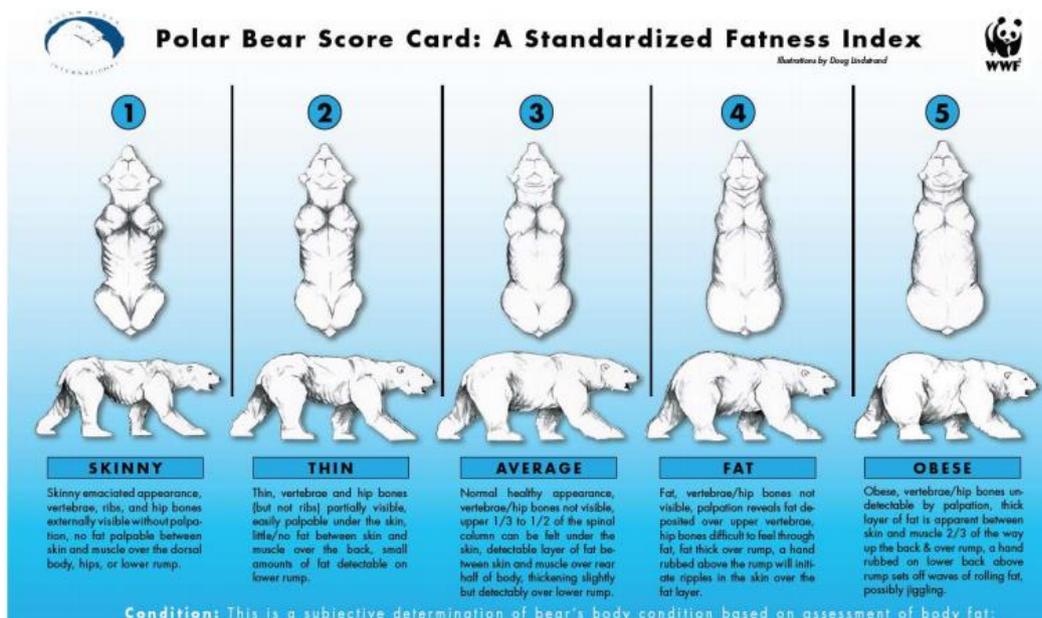


FIGURE 7. SOURCE: AZA BEAR TAG, 2009

8.2 Detailed physical examination

8.2.1 Chemical restraint

The drug combination, when using chemical restraint, is dependent upon the length and invasiveness of the procedure, medical history of the animal, and experience of veterinary staff. Before chemical restraint is administered a fasting protocol of a minimum of 8 hours should occur. For chemical restraint drug delivery can be done via a pole syringe or blow dart; this method, using injectable anaesthetics works well for non-invasive procedures, although it is advised for longer procedures that gaseous anaesthetic, such as isoflurane, is provided via a facemask or endotracheal (ET) tube (adults on 11-14mm/0.4-0.55n in ET tubes) (AZA Bear TAG, 2009).

8.2.2 Physical examination

Physical examinations of polar bears should include the following:

- Venipuncture for CBC/serum, chemistry/serum bank, heartworm antigen-antibody where appropriate
- Immunization updates
- Weight measurement
- Palpation (whole body – as fur may obscure masses/lesions)
- Auscultation
- Dental evaluation and cranial radiographs
- Skin and fur evaluation
- Feet evaluation (to detect of abscesses/dermatitis)
- Identification microchip reading or placement (intramuscularly between the scapula)
- Urinalysis
- Cardiac evaluation in older bears (thoracic ultrasound)
- Otic/ophthalmic exams
- Reproductive evaluation (status, history and SSP Program recommendations)
- Blood collection and analysis

It should also be noted that these evaluations must also be undertaken when a new bear comes through quarantine (AZA Bear TAG, 2009).

8.3 Routine treatments

There are two ways to perform routine treatments. The first being under anaesthetic and the second being conducted at the animal's habitat with assistance from keepers. During the second method nutrition and husbandry procedures are reviewed, as well as the animals' condition with the help of trained medical behaviours (ie. "open mouth" for an oral exam, "paw presents" to evaluate dorsal and ventral surfaces of the feet and nails, presentation for limbs for administration of immunizations via projectile dart, and blood collection via rear leg vein). If any health concerns are raised after routine treatments, then an immobilization can be organised to address these issues. In case immobilization is required keepers should be aware of normal adult polar bear physiological condition (fig.7). It is also required by the USDA AWA that marine mammals have at least a visual exam by the attending of a veterinarian every 6 months (AZA Bear TAG, 2009). Figure 8 shows the normal temperature, pulse and respiration rates of an adult polar bear.

	Immobilized	Awake**
Temperature	37.2-38.4°C (99-101°F)	36.5°C (97.7°F)
Pulse	120 beats/min*	60-90 beats/min (sitting) 30-40 beats/min (asleep) 45-60 beats/min (awake/inactive) 80-150 beats/min (active/moving)
Respiration	17 resp/min*	15-30 resp/min

FIGURE 8. THE NORMAL TEMPERATURE, PULSE AND RESPIRATION RATES OF AN ADULT POLAR BEAR. SOURCE: AZA BEAR TAG, 2009

8.4 Known health problems

8.4.1 Bacterial diseases

Leptospirosis *Leptospira spp.* – (Zoonotic & Quarantine required)

Cause: Direct or indirect contact with urine, placental fluids, or milk contaminated with the *Leptospira spp.* Bacteria. It is also carried by rodents.

Signs & Symptoms: Fever, vomiting, diarrhea, and death

Prevention: if animals are known to be carrying bacteria, then do not come into any form of contact with them and follow correct vaccination procedures. Keep rodents to an absolute minimum around and in bear enclosures.

Treatment: Vaccines are available in the USA and some other countries for animal use.

Can be treated with Chloramphenicol. Adults should receive annual vaccinations of *Leptospira* bacteria if there are concerns of rodent vectors (AZA Bear TAG, 2009; Dierauf, 2007).

Salmon Poisoning (Rickettsial disease) – (Zoonotic) (fig. 9)

Cause: Salmon poisoning is caused by rickettsial agents, *Neorickettsia helminthoeca* and *Neorickettsia elokominica*, which live in the fluke *Nanophyetus salmincola*.

Signs & Symptoms: vomiting, anorexia, diarrhea, dehydration, swollen lymph nodes, lack of appetite, and lethargy.

Prevention Methods: Avoid feeding salmonid fish from the Pacific Northwest, or fish that have been thoroughly frozen.

Treatment:

Any one of the following can eliminate rickettsial infection:

- tetracycline 20 mg/kg orally every eight hours for three weeks
- oxytetracycline 7mg/kg intravenously every 12 hours until oral dosing is tolerated.
- chloramphenicol 30 mg/kg orally or intravenously every eight hours
- trimethoprim sulphadiazine 15 mg/kg orally or subcutaneously every 12 hours.

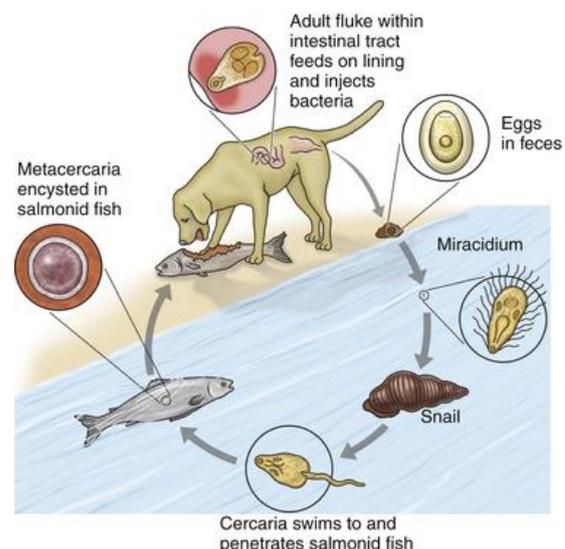


FIGURE 9. THE LIFE CYCLE AND HOW SALMON POISONING OCCURS. SOURCE: VETERIAN KEY, 2016

- sulfadimethoxone/ormetoprim first dose 55mg/kg orally then 27.5mg/kg orally once daily.

Elimination of fluke:

-fenbendazole 50mg/kg orally once daily for 10-14 days (Wildpro; Zutrition, 2013; AZA, 2007).

Brucella spp. Bacteria – (Zoonotic)

Cause: direct contact with or eating animals that contain the bacteria.

Signs & Symptoms: It is found in many marine species such as Ringed Seals (*Phoca hispida*), a Polar Bears main source of food; and is known to create reproductive issues in some marine species. Although no reproductive concerns have been reported in Polar Bears. Signs and symptoms in people include: fever with fluctuations in temperature.

Prevention: Do not eat infected dairy products (milk), infected animals, or have direct contact with an infected animal.

If coming into contact with infected animals, wear rubber gloves and undertake appropriate hygiene techniques after contact. Quarantine requirements are unknown.

Treatment: There is currently no treatment for an infected animal (Tryland et al. 2001).

Tetanus – (Quarantine required)

Cause: A bacteria that produces toxins that affects the nervous system. Bacteria is found in soil, dust and manure.

Signs & Symptoms: muscle spasms, lockjaw, problems with swallowing, breathing difficulties, abnormal heart rhythms, painful convulsions.

Prevention: correct hygiene procedures must be undertaken.

Treatment: Cubs to be given 2ml of Tetanus toxoid vaccination at 16 weeks of age, and then a follow up vaccinations. Adults should receive annual vaccinations of Tetanus Toxoid. (Wildpro; AZA Bear TAG, 2009; Better Health, 2016).

Gastritis

Cause: the ingestion of dirt, sand, salt water or garden chemicals, alongside sudden diet changes.

Signs & Symptoms: vomiting, salivation, abdominal pain, depression, and abdominal distention.

Prevention: following correct cleaning and hygiene procedures when cleaning out enclosures and food/water dishes.

Treatment: withhold the normal diet and offer ice cubes instead of water. Provide a bland diet. If diarrhea present, give keopectate, 15mL/kg every eight hours.

If there are foreign bodies lodged in the stomach, gastrostomy is required to remove them (Wildpro).

8.4.2 Fungal diseases

Blastomycosis – (Quarantine required)

Cause: caused by an infection of parasitic fungi that affects the skin and internal organs.

Signs & Symptoms: lethargy, anorexia with weight loss.

Prevention: unknown

Treatment: Itraconazole 4.5mg/kg/day which is divided into two oral doses for 90 days (Dierauf, 2001; AZA, 2007).

Bacteria Dermatitis *Dermatophilus congolensis* – (Quarantine required)

Cause: Wetting can release zoospores, biting fleas can transmit zoospores and can cause lesions.

Signs & Symptoms: Hair colour changes from white to yellow-white, then becomes dark and greasy; diffused exudation, hair matting, and red wet skin beneath scabs.

Prevention: Maintain correct hygiene practices to prevent the presence of infected insects.

Treatment: Can be treated with a number of treatments:

- Penicillin G injected by dart twice weekly for four weeks.
- Streptomycin, 5g daily for five days.
- nitrofurazone, 500mg/gallon water sprayed onto each affected bear weekly; later chloramphenicol, 10g/gallon weekly.
- Supplementation of cod liver oil in the diet (two cups a day) reduces resolution of lesions (Wildpro; Dierauf, 2001).

8.4.3 Protozoa diseases

(There was no known Protozoa Diseases listed for Polar Bears)

8.4.4 Viral diseases

Rabies *Lyssavirus spp.* – (Zoonotic & Quarantine required)

Cause: An infection that is caused by the genus *Lyssavirus*. It's transmitted from the saliva of an infected animal via a bite.

Signs & Symptoms: Loss of appetite, lethargy and fever. Symptoms that follow shortly include ataxia and nervous system dysfunction.

Prevention: avoid handling, feeding, or any contact with infected or possibly infected animals.

Treatment: Vaccination programs (AZA, 2007; Department of Health, 2013; Hosey et al. 2009; Dierauf, 2001).

Morbillivirus – (Quarantine required)

Cause: leading cause to canine distemper virus (CDV), phocine distemper virus (PDM), and pilot whale morbillivirus (PWMV).

Signs & Symptoms: affects the lungs, brain and immune system. Possible skin and lung lesions can also occur.

Prevention: Do not eat or come into contact with infected animals (ie. Fish).

Treatment: Rabies immunizations – cubs at 16 weeks of age should be given 2ml of rabies vaccine, with a follow up of the vaccine (NOAA Fisheries, 2015; Dierauf, 2001; Hosey et al. 2009).

8.4.5 Nutritional diseases

Neoplasia (Hepatic and bile duct tumors)

Cause: Mycotoxins (eg. Aflatoxin) are suggested to be a possible cause. Also genetic

predisposition and captive diet can contribute; hereditary and environmental factors may also play a part.

Signs & Symptoms: lethargy, weakness, vomiting, weight loss, abdominal distension, jaundice, ascites, coma.

Prevention: reducing the fat content in the diet to 2-4%, and more natural ingredients such as formic acid and propolis, should be added to the diet.

Treatment: Due to the extent of the tumor euthanasia is the best choice. (AZA Bear TAG, 2009; Dierauf, 2001).

Vitamin A Deficiency

Cause: Prolonged dietary deficiency

Signs & Symptoms: low reproductive rates, coat problems and possibly mortality.

Prevention: Supplementing Vitamin A into the diet via dry matter (dry food).

Treatment: A minimum dietary requirement of Vitamin A content is 5 IU/g dry matter. (Zutrition, 2013)

Arthritis and Skeletal Disease in Bears

Cause: Lack of appropriate activity

Signs & Symptoms: erosion of the articular cartilage causes severe pain, loss of movement, stiffness and difficulties walking, sitting and rising.

Prevention: ensuring that captive bears are having appropriate levels of activity.

Treatment:

- Anti-inflammatory and analgesic drugs such as NSAIDs
- Prednisolone, 80mg on days 1, 3, 5, 7, 8 9 and 40 mg on days 2, 4, 6, 8, 10. Then reducing it down to 60 mg on 'odd' number days and 25 mg on 'even' days. (Wildpro)

8.4.6 Parasitic infections

Parasitic Mite Infection of the Skin *Arsicoptic mange* – (Quarantine required) (fig. 10)

Cause: Mites burrowing into the skin of its host to lay eggs.

Signs and Symptoms: Skin may become itchy and smelly; bald patches may become present from scratching. Skin scrapings can be taken to detect mites. Rubbing, scratching or chewing infected areas.

Prevention: Keep other bears away from infected bear. Continue treatment of infected bear until the infection is gone.

Treatment: Sprat with amitraz in a 250ppm solution (one 10.6ml bottle of Mitaban, Upjohn Co. liquid concentrate) in two gallons of warm water.

Repeating injections of ivermectin can be effective. Supplements of vitamin A can also help to improve the condition of the skin (AZA Bear TAG, 2009; AZA, 2007; Wild Pro).



FIGURE 10. WHAT A BEAR WILL LOOK LIKE IF INFECTED WITH MANGE.
SOURCE: WIDE OPEN SPACES, 2016

Hookworm Infection *Ancylostoma spp.* – (Zoonotic)

Cause: transmitted through milk, possibly causing a peracute disease.

Signs & Symptoms: Blood in feces, anorexia, weight loss.

Prevention: Prophylactic treatment with anthelmintic every four to eight weeks.

Treatment:

- Ivermectin, 0.3mg/kg subcutaneously once, repeated at eight week intervals.
- Levamisole, 10mg/kg subcutaneously, repeated as required (Wildpro).

Tapeworms (Cestode Infections) – (Zoonotic)

Cause: development of cestodes can be due to an enhanced carbohydrate-rich diet, certain vitamin deficiencies, and seasonal changes. Known to be ingested from salmon.

Signs & Symptoms: loss of body condition, diarrhea, constipation, and anemia.

Prevention: Diet consists of fresh food. If fish is fed it has been frozen for at least 24 hours and meets criteria for fish feeding acceptability.

Treatment: Praziquantel, 5mg/ kg subcutaneously or orally (AZA Bear TAG, 2009).

8.4.7 Endoparasites

Baylisascaris sp. (Round Worm) – (Zoonotic) (fig. 11)

Cause: extensive damage to their hosts. Growing and migrating sometimes towards the Central Nervous System or the eyes.

Signs & Symptoms: infections that cause intestinal obstruction and weight loss.

Prevention: 6-8 week deworming programs, and fecal direct and floatation exams should be performed twice a year.

Treatment: Milbemycin oxime 20mg/kg/d x 3 orally (The Centre for Food Security & Public Health, 2013; Dierauf, 2001).

Trichinella sp. (Round Worms) – (Zoonotic)

Cause: caused by nematodes.

Signs & Symptoms: muscular pain and eosinophilia, possibly central nervous system is also affected.

Prevention: Avoid or cooking potential meat sources of the parasite.

Treatment: Follow deworming program instructions (AZA Bear TAG, 2009; Dierauf, 2001).

Heart Worm – (Zoonotic) (fig. 12)

Cause: parasitic worm, *Dirofilaria immitis*.

Signs & Symptoms: fatigue, decreases appetite, weight loss

Prevention: Heartworm ELISA antigen tests should be conducted.

Treatment: Heartworm preventative programs need to be undertaken (ie. Ivermectin 200ug/kg orally monthly). (AZA Bear TAG, 2009).

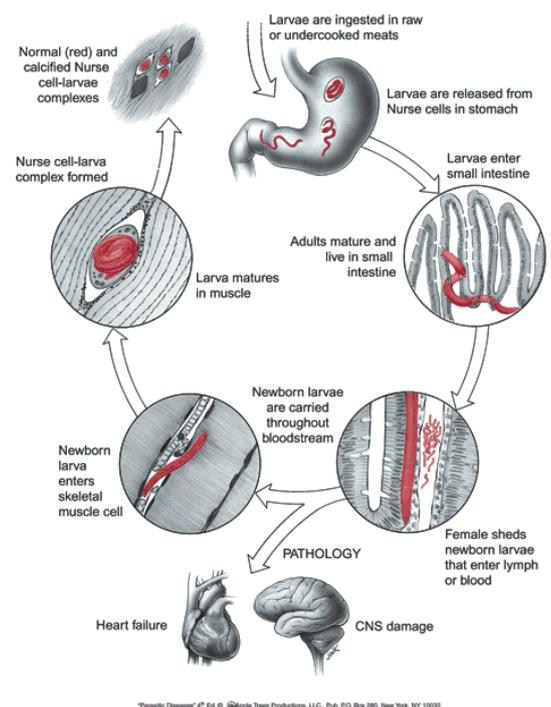


FIGURE 11. THE LIFE CYCLE OF ROUND WORMS.
SOURCE: TRINCHINELLA, 2004

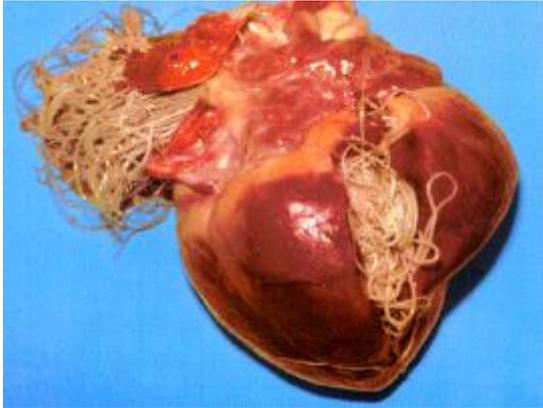


FIGURE 12. WHAT A HEART WILL LOOK LIKE WHEN INFECTED BY HEARTWORM. SOURCE: PET NETWORK INCLINE VETS, 2013

8.4.8 Ectoparasites

Blue-Green Algae (fig. 13)

Cause: growth of a cyanophyte within the shaft of the hair.

Signs and Symptoms: Greening of the hair coat.

Prevention: water treatment measures which reduce the presence of algae in the water.

Treatment: salt-water treatments and peroxide baths (AZA, 2007).



FIGURE 13. WHAT THE COAT OF A POLAR BEAR WILL LOOK LIKE IF INFECTED WITH BLUE-GREEN ALGAE. SOURCE: SCIENCE 20, 2014

8.5 Quarantine requirements

“All quarantine procedures should be supervised by a veterinarian, formally written, and available to staff working with quarantined animals” (AZA Bear TAG, 2009, p.37). The quarantine area can be established in a hospital building that is completely separate from the main exhibit (AZA Bear TAG, 2009).

8.5.1 Zoonotic diseases and quarantine

According to AZA, institutions must have prevention procedures and training protocols for

zoonotic diseases to minimise any risks that are associated with the transfer of diseases. There should be specific keepers designated to bears in quarantine, if this is not possible then quarantine bears should be treated only after resident bears. This is the same for any equipment used to feed, care for, and enrich polar bears housed in quarantine. If there is not enough equipment available to split between resident bears and bears in quarantine, then all equipment must be properly disinfected, as designated by the veterinarian supervising the quarantine procedures before the use with resident bears (AZA Bear TAG, 2009).

8.5.2 Quarantine duration

Polar bears that have been brought into a new facility are required to be in quarantine for a minimum of 30 days. Although if the bear has infectious issue then the bear is required to be isolated for a longer time period, or as directed by the veterinarian. In addition polar bears are introduced to the facilities before the original quarantine period had finished then the quarantine period for all bears must begin again (AZA Bear TAG, 2009).

8.5.3 Quarantine protocols

Because Polar bears are not usually a social species, isolation during quarantine is not usually an issue. The only exception for these animal is if cubs were separated from their mother for the first time. Enrichment is a very important part of quarantine protocols so complexity of space can be maximized, and animals are provided with opportunities to perform species-appropriate behaviours. Diet is also an important factor as animals who have come from a different institute may have had a different diet, so a transitional period should be put in place for the new diet which should begin no sooner than the second week of quarantine (AZA Bear TAG, 2009).

8.5.4 Quarantine examinations

Whilst bears are in quarantine an examination of faeces for parasites via direct examination and floatation should be performed, and any necessary de-worming treatments administered. Bears need to also be evaluated for ectoparasites whilst in quarantine, and treated accordingly (AZA Bear TAG, 2009).

8.5.5 Necropsy

Whilst in quarantine, if a bear is to die a necropsy should be undertaken and the, 'subsequent disposal of the body must be done in accordance with any local or federal laws' (AZA Bear TAG, 2009, p.38). Necropsies must include a detailed external and internal gross morphological examination and representative tissue samples from the body organs should be submitted for histopathological examination (AZA Bear TAG, 2009).

9. Behaviour

9.1 Activity

Although Polar bears are well known in the wild for the important apex predator role they play, they are surprisingly most active during the first third of the day and least active during the final third. During warmer months Polar bears have been known to spend up to 87% of their day resting, finding cooler patches of ice or earthen pits to sprawl out on. In cooler months, especially pregnant females, will create dens to hibernate in while the winter weather passes through. Polar bears are not considered deep hibernators, but they do enter a state of carnivore lethargy. Whilst in this state the heart rates slows to 27 beats per minute, body temperature can remain normal or will drop slightly, fat stores will diminish, and females will give birth; this lethargic state will only happen to pregnant females during October until April (SeaWorld, 2017).

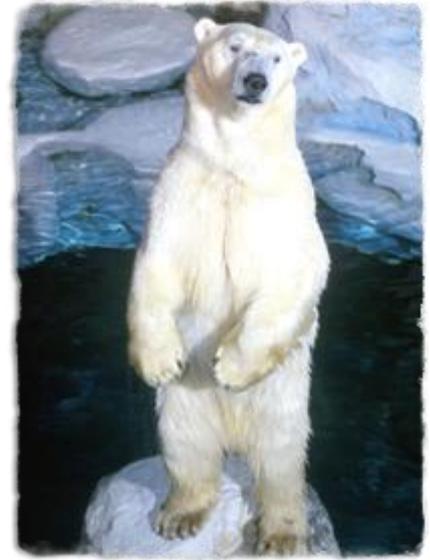


FIGURE 14. SOURCE: SEAWORLD, 2017

9.2 Social behaviour

Polar bears in the wild are generally nomadic animals, but have been observed many times in congregating groups. To meet these needs the exhibits must be large enough so that each polar bear can retreat to an area that is blocked from view on at least one side of the exhibit. Each polar bear should have an off exhibit area that they have the ability to access at all times. In the wild pregnant females stay away from male bears and other animals so it's important that these needs are met in captivity (AZA, 2007).

9.3 Bathing

Polar bears are known to keep their fur well groomed to keep it well insulated. In summer bears have been observed spending time in the water washing out their fur, during the winter if there is open water available they will utilise it, otherwise they will use snow to remove any unwanted dirt (Polar Bears International, 2016). Additionally the environment of the enclosure must provide diversity and the possibility to easily re design. All exhibits must contain 'resting platforms, water features, and nesting sites' (AZA, 2007). Elevated areas must be designed so bears of all ages have access to them. Foraging pits and underwater boulders should also be included as they have been associated with decreasing stereotypical behaviour (AZA, 2007).

9.4 Behavioural problems and Signs of stress

Behavioural problems that are well known in polar bears include negative foraging behaviours during spring and summer (Zutrition, 2013). Signs of stress that keepers should also look out for include inconsistent feeding behaviours, pacing back and forth, aggressive towards keepers, bears constantly cleaning themselves, killing and eating of cubs, self-mutilation, vomiting, regurgitation, and playing with or eating their own excrement (Born Free, 2016; AZA Bear TAG, 2009).

9.5 Behavioural enrichment

Table 2 below includes a detailed description and example of a behavioural enrichment plan designed for captive Polar bears.

TABLE 2. EXAMPLE ENRICHMENT PLAN FOR CAPTIVE POLAR BEARS

Common name:	Polar Bear		Behaviour notes (i.e. anything to do with the species, or individual animal’s behaviour that may affect the plan): Aggression towards other bears during scatter feeding. The bear may accidentally harm itself when playing with an object. Objects must be placed around the exhibit that suit the age of the bear. ie. An older arthritic bear may not be able to reach food that is placed in areas that require it to climb.				
Scientific name:	<i>Ursus maritimus</i>						
Approx. age:	7						
Sex:	Male						
*No.	Enrichment item or activity	Materials and resources needed	Type of enrichment	Goal or overall purpose	Benefits to the animal	Frequency	Potential risks to either the animal/s and/or people
1.	Food scattering	Anything from hard boil eggs, whole pumpkins, water melons, cow hooves or ears (substituted with pig), freeze dried liver, and peanut butter spread around the exhibit in a variety of different areas that make the bears work	Food	To encourage the bears to look and find their food	The bear will be given the opportunity to use natural senses to search for food.	Twice every two weeks	If the bears escape from off-exhibit into exhibit area, while the keepers are setting items up in the enclosure a danger does exist.

Husbandry guidelines for Mammals TEMPLATE

		to find the food.					
2.	Food in Ice / Puzzle blocks	Large freezer blocks or puzzle blocks that can be placed around the exhibit and in pools that contain meat products ie. Fish, chicken liver, cow liver, and cow hooves or ears (substituted with pig).	Food	Encourages bears to use natural instincts when removing food from ice.	Bears will be able to use their natural instincts to find the food will also get to use their claws, paws, teeth and over all body strength to break the ice to get to the food.	Twice every two weeks	If the bears escape from off-exhibit into exhibit area, while the keepers are setting items up in the enclosure a danger does exist. Bears could possibly do damage to teeth when trying to get food out of the ice.
3.	Scent	Pine cones, grapevine wreathes, corn stalks, spices, catnip and hoof stock hair placed around the exhibit.	Physical	To encourage natural foraging behaviours.		Zero to twice a week	If the bears escape from off-exhibit into exhibit area, while the keepers are setting items up in the enclosure a danger does exist.
4.	Sound	Seal and bird vocalizations	Physical			Zero to twice a week	No potential risks exist.
5.	Terrestrial Activates	Plastic buckets, traffic	Social	Encourages bears to play	Bears will be able to practice	Twice every week	If the bears escape

Husbandry guidelines for Mammals TEMPLATE

		cones, phone books, cardboard piñatas, picnic tables and piles of ice/snow.		outdoors and be social alongside one another in the public's view.	skills such as using their teeth and claws to tear at books, they will be able to chew on items, climb to reach items and relax and lay about on items that wouldn't normally be in the exhibit.		from off-exhibit into exhibit area, while the keepers are setting items up in the enclosure a danger does exist. Possibility of bear harming itself whilst playing with the object.
6.	Water Activities	Large floating balls, cut up rubber and canvas hoses, beer kegs and water cooler jugs.	Social	Encourages bears to play with items in the water together or alongside each other		Twice every week	If the bears escape from off-exhibit into exhibit area, while the keepers are setting items up in the enclosure a danger does exist. Possibility of bear harming itself whilst playing with the object.

9.6 Introductions and removals

Polar bear introductions must be well planned and not rushed. The following are basic steps that should be undertaken when introducing Polar Bears:

1. Keepers specifically working with the polar bears need to establish a familiar routine

when a new bear comes into the facility; the caretakers and the bear need to become familiar with one another.

2. The bear must be given sufficient time to adjust to its new surroundings before it is introduced to other bears; this adjustment period could take around a month or more depending on the individuals involved. Bears must be familiarized with all exhibit and holding areas, should shift between habitat without hesitation, eat regularly, and respond to trainers before any animal introductions are attempted.

3. Only two bears should be introduced at one time.

4. Bears must be kept in adjacent areas for introductions. The two bears must have olfactory and visual access to one another without the risk of injuries occurring. Keepers should not be in the immediate area the entire time, observations and monitoring of behaviour must happen from afar. If any negative or stress like behaviours begin to be displayed the introduction should be ended and the bears should be allowed more time to acclimate before any more introduction attempts occur.

5. When the pair appear to be at ease at the visual access point, as demonstrated by lying side-by-side, nose-to-nose, or by one animal presenting itself in a vulnerable position while the other animal reacts non-aggressively, they are ready for partial introduction, allowing bears to get a paw or part of their muzzle through the access point if the facility design allows (AZA Bear TAG, 2009).

9.7 Intraspecific compatibility

As long as male polar bears are not exposed to females in adjoining areas compatible male polar bears can be housed together for years. Castrated males are also known to happily be housed with females. Although housing polar bears, just like other animal species, comes down to the temperament of the animal, which needs to be taken into account when determining appropriate social group sizes and structures (AZA Bear TAG, 2009).



FIGURE 15. SOURCE: SEAWORLD, 2017

9.8 Interspecific compatibility

Due to their aggressive nature Polar Bears should not be housed with different animal species (AZA Bear TAG, 2009).

9.9 Suitability to captivity

As long as the size and complexity of the habitat is sufficient, polar bears are capable of managing social distance and minimizing aggressive interactions. If an exhibit is properly designed and appropriate behavioural management techniques are put in place to create a healthy social environment, substantial conditions to enhancing the welfare of polar bears in zoos and aquariums will exist (AZA Bear TAG, 2009).

10. Breeding

10.1 Wild and Captive Breeding Behaviours

10.1.1 Wild Behaviours

During breeding season males will begin to show courtship behaviours towards the female. They will begin to follow the female around, play with one another, and the female will show more acceptance of the male's presence. These behaviours can last throughout the whole breeding season which is from January to May (AZA Bear TAG, 2009).

10.1.2 Captive Behaviours

Normal

- Males showing signs of aggression towards mother and cubs.
- Young Bears may need more time together before attempts of breeding can occur.
- Pregnant females who are placed into the cubing den will settle into the new habitat with ease.
- Throughout the pregnancy the female will begin to fast, especially close to the birth where she is most likely to refuse food all together.

Abnormal

- The female may not be receptive to the male throughout the whole breeding season.
- Temperature can cause females to completely abandon new born cubs.
- Un-pregnant females who are isolated in the cubing den will begin to bang and scratch on the door wanting to get out.
- Aggression towards cubs.
- Leaving the den area for long periods of time.
- Excessive noise/crying from cubs without any attention from the mother.

10.2 Conservation Status and Previous Success of Breeding in Captivity

Polar Bears are currently listed as vulnerable on the IUCN Red List (IUCN Red List, 2017). Across zoos in North America it was recorded that between 1912 and 2010 697 individuals were captivity born. Unfortunately half of these individuals did not survive past 30 days of age, and were more likely to die if born in litters of multiples if still in the neonate phase. Although, individuals that did survive lived longer in captivity than in those in the wild (Cincinnati Zoo, 2017; Curry et al, 2015).

10.3 Reproductive Anatomical Structures and Physiological Features

Polar Bears are sexually dimorphic animals with the males begin larger than the females; the average weight of a male is 544-600kg, and the female is 295-330kg (Wildpro, 2017). Because both female and male have so much fur cover it can be difficult to tell between the

two sexes, when bears are young sexes can sometimes be identified via head size, males will generally have a larger head than females (AZA, 2007). Both have basic genitalia, the male has a nublike penis which will extend when the baculum (a bone) is triggered from excitement (fig. 16 a); the female genitalia is similar to many other animals (fig.16 b) (SammySee, 2017).

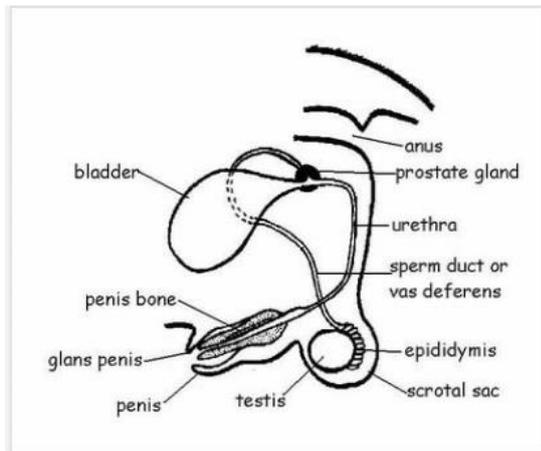


FIGURE 16 A. REPRODUCTIVE ANATOMICAL STRUCTURES OF MALE POLAR BEAR. SOURCE BLACK BEAR RESOURCE, 2017

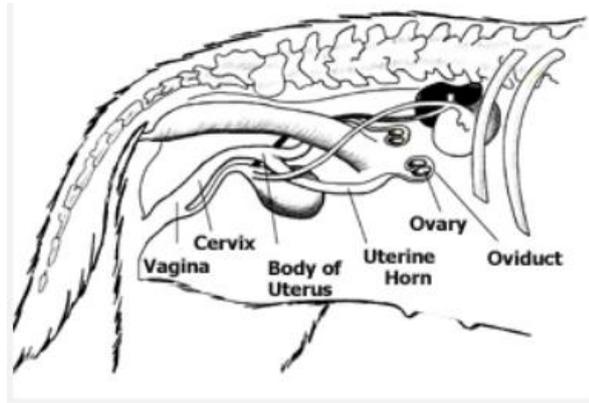


FIGURE 16 B. REPRODUCTIVE ANATOMICAL STRUCTURES OF FEMALE POLAR BEAR. SOURCE BLACK BEAR RESOURCE, 2017

10.4 Techniques used to control breeding

Reproduction in Polar Bears can be controlled through the use of hormonal contraceptives, which can be temporary and reversible (Cincinnati Zoo, 2017).

10.5 Courtship

With breeding season beginning in February and finishing in May Polar bears begin showing courtship behaviours as early as January. Courtship behaviour include anything from the male following the female around, increased play behaviour, and an increased acceptance from the female of the males presence.

10.6 Onset of breeding

Females reach sexual maturity at 4 years of age, and will successfully give birth at 5 years; males are sexually mature at 3- 6 years of age. When males become sexually mature they may show signs such as males following females around or showing aggression/fighting with other males over females. Females who have reaches sexual maturity during mating season may become more social with the males, presenting themselves to the chosen male and/or playing with him.

10.7 Mating/Copulation

Mating occurs annually and once paired the male and female will stay together for a week or more mating more than once. Polar bears will have more than one mate throughout their

lives. Mating can occur more than once, but this will happen around every three years as cubs are known to stay with their mother for 2-3 years before weaning from her.

10.8 Facilitating Mating

While mating and pregnancy is occurring the normal routine with no change of staff should be kept as close to normal as possible. The mating pair should be introduced slowly, firstly starting with separate enclosures that are beside one another. The amount of time that the bears are separate from one another depends upon how well the bears respond to each other. Pairs that begin to respond well to one another will begin to act playful, may urinate along that side of the enclosure, and the females may even start turning around and presenting to the male.

10.9 Artificial Insemination

Artificial Insemination (AI) methods have begun to be researched and developed for polar bears. The sperm collection is done by using a minimally-invasive method that requires the use of a catheter to be threaded into the urethra, a syringe that is used to withdraw the sperm, and an aesthetic drug, medetomidine, which induces ejaculation/causes semen to pool in the urethra while the bear is unconscious. This method has a 91% success rate, creating the very first polar bear sperm bank. Although little is known about the use of exogenous hormones to overcome infertility in females polar bears. There has been variable success of ovulation induction using exogenous hormones, with more precise dosage and timing of dosage needing to be improved (Cincinnati Zoo, 2017)

10.10 Nesting, hollow or other requirements

The cubing den must be built in a quiet area away from the main exhibit, but should still have outside access. Skylights should be used in cubing dens to provide natural lighting. Indoor lighting that mimics natural light patterns of the geographic area of the exhibit can also be used (AZA Bear TAG, 2009; AZA, 2007). The optimum humidity range for polar bears is currently unknown, therefore great care should be taken when monitoring the interaction between high temperatures and high humidity, so that the bears can still regulate their body temperature at all times. If the temperature are is to high female polar bears who have recently given birth have been known to abandon their cubs, an ambient temperature of 18°C is suggested to be most suitable. To help minimise humidity stressors providing the female with self-draining substrates or nesting materials such as wool, mulch, bark chips, straw, or hay will help to decrease any issues and allow the female to act with natural instincts and create herself a nest/den where she will give birth (fig. 17) (AZA Bear TAG, 2009; Maryland Zoo, 2017). When the female is placed into the cubing den and is officially determined as pregnant staff should maintain their normal routine, with no changes made. Sudden changes to normal routines can create stress for the pregnant female. The age and suitability of the breeding pair can also play a part as young and inexperienced polar bears may not breed for a few years. Breeding pairs must be carefully matched as different



FIGURE 17. CUBING DEN
SOURCE: MARYLAND ZOO, 2017

personalities can cause clashes and be a reason for breeding to not occur (AZA Bear TAG, 2009). The best media used to monitor the fertilisation and birthing process is video and audio equipment (fig. 18) that is placed in low-mid section of the cubing den (AZA Bear TAG, 2009).

10.11 Breeding diet

Pregnant females need very little physical, social and food-related enrichment. Because they become less active and appetite decreases creating a stress free environment with no changes is the best way to keep pregnant females relaxed and happy. Water should also be continually supplied via water dishes that can automatically refill themselves (AZA Bear TAG, 2009). Pregnant females may need an increase in carcass consumption to meet protein requirements. This method may need to be used earlier on as appetite decreases further into pregnancy. As appetite decreases dry food should be given as it will lessen the chance of bacterial overgrowth (AZA Bear TAG, 2009).



FIGURE 18. MEDIA USED TO MOITOR PREGNANT FEMALE.
SOURCE: MARYLAND ZOO, 2017

10.12 Oestrous cycle and gestation period

There is currently no way to tell if a polar bear is pregnant. The only thing keepers can do is if they suspect a female is pregnant, to place her in the denning area. After a few days the bear will settle in, she will also begin to stop eating especially close to the birth of her cubs. A bear that is not pregnant will continually bang on the door of the denning area wanting to get out. The gestation period of a polar bear is 195-265 days.

10.13 Age at weaning

It's suggested that cubs should only be weaned from the mother if the mother is showing signs that she is incapable of taking care of the cub/s herself or the cubs are showing signs of illness. The best time to separate and wean a cub from its mother is when the mother and cubs start to leave the den, which is around 70 – 85 days (AZA Bear TAG, 2009).

10.14 Age of removal from parents

If cub/s are to be moved to other zoos then they will stay with their mother for up to a year, otherwise healthy cubs can stay with their mothers for 2 -3 years before fully being weaned (AZA Bear TAG 2009).

10.15 Monitoring Processes and Records

Each bear has individual ID numbers in the medical records. Polar bears should also be identified individually by visual appearance and behaviour, via an ID microchips, and lip tattoos can also be used (AZA, 2007). Polar Bear Studbooks and health records are heavily relied upon by zoo keepers and contain information such as patterns of reproduction, cub survival, parturition, parental demographics, stereotypic behaviour, responses to enrichment initiatives, conspecifics (AZA Bear TAG, 2009).

10.16 Emergency Procedures/WHS Considerations

Hand-reared cubs may appear tame throughout most of their life, but keepers must remember that they are still capable of killing someone or another polar bear. Safety protocols must be followed. These protocols may include ensuring the proper use of redundant locking mechanisms, keeper labels on entrances, gates and doors, following lock and check protocols are followed correctly so keepers are safe at all times (AZA Bear TAG, 2009).



FIGURE 19. SOURCE: PETER MARIJINISEEN, 2016

11. Artificial rearing

11.1 Background

At birth polar bear cubs can between 600-700 grams. Twin cubs are extremely common, although as many as four cubs can be born. There are medical problems such as rickets/vitamin D deficiency, lactobezors, constipation, dehydration, and boating which are all associated with formula composition. Figure 20 below shows when cubs reach certain development stages during the first few months of their life (Zutrition, 2016; Polar Bear Nutrition Guidelines, 2006).

<u>Developmental milestones in captive polar bears</u>	
<u>Milestone</u>	<u>Age (days)</u>
Eyes open	24-42
Incisors erupt	36-53
Canines erupt	46-53
Stand	60-82

FIGURE 20. DEVELOPMENT MILESTONES IN CAPTIVE POLAR BEARS. SOURCE: ZUTRITION, 2016

11.2 Housing

To begin with cubs are kept in an isolette, cubs that are growing much faster (as males will generally do) can be moved and placed into a large box that allows for temperature and humidity to be maintained. From around three weeks of age cubs can be moved into an infant play-pen that is lined with rigid sheets of vinyl. The play pen floor should be covered or lined with a play-pen pad and then nylon carpet placed on top to allow cubs to firmly grip the surface. Once cubs reach a stage where they are comfortable with the room temperature they can be moved into a hardboard-lined playpen (Wildpro, 2017).

11.3 Temperature requirements

Polar bear cubs or neonates that are hand reared should be initially maintained within an incubator at a temperature of 29-31°C (84.2-87.8°F) until they are two weeks of age. At two weeks they will have grown their natal coats and will now have thermoregulatory abilities (Kenny & Bickel, 2005; AZA Bear TAG, 2009; Zutrition, 2016). It should be noted that if at

two weeks of age cubs begin to become distressed and vocalisations are at abnormal activity levels the temperature should be decreased to 18°C (64.4°F), as stress due to overheating may be occurring (Kenny & Bickel, 2005; AZA Bear TAG, 2009; Zutirition, 2016).

11.4 Diet and feeding routine

11.4.1 Feeding and Intake

Cubs that have not had an opportunity to nurse should be administered polar bear serum at 3-5ml per pound of body weight in two doses spaced 5-10 days apart. A combination of milk products (cream or half and half) with Esbilac, various dilutions of Esbilac, or a combination of Esbilac and another milk replacer (such as Multi Milk or Enfamil) should be used to hand-rear the cubs on (AZA Bear TAG, 2009). Cubs must be fed 15-25% of their body weight per day, and must not exceed 5% per feeding; once at 90 days of age feedings can gradually tapered off to 10-20% of the cub's body weight. Feedings must be evenly spaced 2-3 hours apart and must reflect the health status of the cubs (AZA Bear TAG, 2009; Wildpro, 2017; Zutirition, 2016). See Appendix A, figures 24, 25 and 26 to see example diets for the following: 1 cub raised in San Francisco from 1 day of age in 1982-1983, 1 cub raised at Brookfield Zoo from 5 days of age in 1999-2000 who had a number of medical issues in the first few weeks after birth, and 2 cubs raised in San Diego Zoo from approximately 90 days of age in 2001.

11.4.2 Elimination

Polar bear cubs need assistance in eliminating faecal matter up until they are 8-10 weeks old when they should be defecating on their own. To assist with elimination the cub must be, "held in a sternal position and the region extending from the belly to the anus gently stroked with a warm, moist cotton ball after every feeding. Only slight pressure is needed to help guide the faecal material through the digestive tract and out of the anal canal" (AZA Bear TAG, 2009, pg. 53). During the first week this process should be performed after every feeding session, after the first week it only needs to be performed twice daily; once solid food is introduced the elimination procedure will only need to occur once daily (AZA Bear TAG, 2009).

11.4.3 Feeding Position

When feeding young cubs, they should be placed in a sternal position – on their stomach on a flat surface (ie. Table) (fig. 21). Placing the cub in this position highly decreases the chance of aspiration and death, which is increased when placing the cub in a position that allows the head to be upright or the head in a backwards position. When feeding the cub in this sternal position a rolled towel can also be provided for the cub to push against, allowing it to control its movements (AZA Bear TAG, 2009).



FIGURE 21. THE CORRECT FEEDING POSITION TO USE WHEN HAND FEEDING POLAR BEAR CUBS. SOURCE: POLAR BEAR SCIENCE 2012

11.5 Specific requirements

When the cubs are removed for the first time from the cubing den they should be removed in a heated insulated box that is lined with a towel and provided with a safe heat source. There are two options that can either be used to provide heat to the cub/s, the first being microwaveable heat pads that can retain heat for four to six hours, the second option is filling latex examination gloves with warm water which can be placed next to the cubs for an initial heat source. The down side to the latter option is that the heat from the water will only last for 30 minutes (Wildpro, 2017). When feeding the cubs human infant bottles, with various nipples, can be used; the use of Playtex nipples can prevent chapping on the cubs' nose. It's important to note that the hole is not too big and allows the cub to suckle without the flow of milk being too rapid (Wildpro, 2017).

11.6 Data recording

The weight of the cubs needs to be recorded at the time each day. After the cubs are initially stabilised they should begin to gain 30-90g of weight per day; with an overall weight gain of 2.25kg by one month of age and then 5.25kg by two months of age. Once cubs become mobile they can be conditioned to step onto scales for weighing (Wildpro, 2017).

11.7 Hygiene

During the first two weeks of cub/s being taken into care only two keepers should be permitted into the area of which the cubs are kept. Before handling the cub/s the two keepers must scrub hands and arms with surgical soap to reduce the risk of passing any unwanted pathogens over to the cub/s. Isolettes should be cleaned and disinfected on a daily basis, with each cub being kept on a decubicare pad that was changed every time it became soiled (Wildpro, 2017), after feeding all utensils must also be sterilised (Wildpro, 2017).

11.8 Behavioural considerations

Littler Mates should be kept together, although if the cubs' are sucking on one another's genitals it may be necessary to separate them (Wildpro, 2017). It should also be noted the normal body temperature of a cub is initially 36°C (98.6°F) rising to 36.2 – 37.2°C (97 - 99°F) and by one to two weeks, 37.8°C (100°F), the temperature and the weight of the cubs should be measured when initially removed, and from there on before every feeding session (Wildpro, 2017).

11.9 Use of foster species

There have been attempts to foster polar bear cubs with other animal species, although the few attempts that have occurred have been with other bear species such as grizzly bears but unfortunately behavioural limitations exist and therefore the use of foster species is not recommended (Polar Bears International, 2017).

11.10 Weaning

In the wild cubs will nurse for up to 2-3 years, with weaning beginning with nutritional and behavioural processes; weaning cubs in captivity is different to in the wild as it involves the cessation of bottle-feeding (Wildpro, 2017; Doctor Lara Croft, 2017; Polar Bear Nutrition

Guidelines, 2006). Weaning cubs off the bottle begins with the introduction of solids in as early as 60 to 85 days; Baby cereal, canned cat or dog food, ground cat or dog food can be fixed with formula to begin the introduction of solid food. When cubs reach 3 months of age they can begin to be offered dog kibble or omnivore biscuit, ground or soaked foods, and then progress to dry food; fish or fresh meats can begin to be offered from 100-110 days. Milk formulas should be discontinued between 3-11 month of age, with a gradual change to solids (Wildpro, 2017; Polar Bear Nutrition Guidelines, 2006).

11.11 Rehabilitation and release procedures

It is recommended by the US Fish and Wildlife Services that the release of hand-reared Polar bear cubs does not occur, due to the hunting and survival skills that would be acquired during the first 2 and a half years of dependence on the mother not being developed in captivity (Wildpro, 2017; Doctor Lara Croft, 2017).

12. Acknowledgements

This Polar Bear Husbandry Manual was developed as a part of the requirements for Certificate III Captive Animals, conducted by Open Colleges. The author would like to sincerely thank the following trainers: Allira May Mathe, Melissa Van Der Boom, Cassandra Rowe, Jacqui Brumm & Chris Hosking for the time and effort spent reviewing and sharing their insight, providing guidance, comments, recommendations, and overwhelming support throughout the development of this Polar Bear Husbandry Manual.

13. References

- Association of Zoos and Aquariums. (2007). Standardize Animal Care Guidelines: Polar Bear (*Ursus maritimus*). Available from: <http://wildpro.twycrosszoo.org/000ADOBES/Bears/D315FinalPolarBearSG2007.pdf> [viewed 23 July 2016]
- Australian Animal Welfare Standards and Guidelines. (2014). Exhibited Animals – General. Available from http://www.dpi.nsw.gov.au/data/assets/pdf_file/0014/510080/guide-exhibited-animals-general.pdf (viewed 28 June 2016)
- AZA Bear TAG .(2009). Polar Bear (*Ursus maritimus*) Care Manual. Association of Zoos and Aquariums, Silver Spring, MD
- Better Health. (2016). Tetanus. Available from: <https://www.betterhealth.vic.gov.au/health/healthyliving/tetanus> [viewed 26 July 2016]
- Black Bear Resource. (2017). The American Black Bear. Available from: <http://blackbearresource.weebly.com/reproductive-system.html> [viewed 16 March 2017]
- Born Free. (2016). ZooChosis: Abnormal and Stereotypic Behaviour in Captive Animals. Available from: <http://www.bornfree.org.uk/campaigns/zoo-check/captive-wildlife-issues/abnormal-behaviours/> [viewed 18 July 2016]
- Chicago Architecture. (2017). Polar bear exhibit drawing. Available from: https://www.chicagoarchitecture.org/2014/05/19/lincoln-parks-coolest-new-homes-are-for-real-animals/lpz-pb-section-through-waterfall_2013-11-02/ [viewed 22 July 2017]
- Cincinnati Zoo. (2017). Polar Bear Signature Project. Available from: <http://cincinnati-zoo.org/conservation/crew/crew-animal-research/polar-bear/> [viewed 16 March 2017]
- Cites. (2013). Convention on International Trade in Endangered Species of Wild Fauna and Flora. Available from: <https://www.cites.org/eng/disc/text.php#III> (viewed 14 July 2016)
- Curry, E., Safayi, S., Meyerson, R., & Roth, T. (2015). Reproductive trends of captive polar bears in North American Zoos: *A historical analysis. Zoo and Aquarium Research*. Vol 3 (3). pp 99 – 106
- Defenders of Wildlife. (2017). Polar Bear: *Basic facts about polar bears*. Available from: <http://www.defenders.org/polar-bear/basic-facts> [viewed 22 July 2017]
- Defenders of Wildlife. (2017). Threats to Polar Bears. Available from: <http://www.defenders.org/polar-bear/threats> [viewed 22 July 2017]

Department of Health. (2013). Rabies, Australian bat lyssavirus and other lyssaviruses.

Available from:

<http://www.health.gov.au/internet/main/publishing.nsf/Content/ohp-rabies-consumer-info.htm>. [viewed 26 July 2016]

Dierauf, L. Gulland, FMD. (2001). CRC handbook of marine mammal medicine: health diseases; and rehabilitation. CRC press

Doctor Lara Croft. (2017). Special Care of Orphan Baby Polar Bears. Available from:

<http://doctorlaracroft.com/content/special-care-orphan-baby-polar-bears> [viewed 18 July 2017]

Environment and Natural Resources. (2011). Capturing, Handling and Release of Bears.

Available from

http://www.enr.gov.nt.ca/sites/default/files/guidelines/nwtwcc_sop_bears.pdf
(viewed 28 June 2016)

Environment and Natural Resources. Polar Bears. Available from

<http://www.enr.gov.nt.ca/node/11> (viewed 28 June 2016)

GOV.UK. (2014). Balai Directive: registration of premises to export animals. Available from:

<https://www.gov.uk/government/publications/balai-directive-registration-of-premises-to-export-animals> (viewed 14 July 2016)

GOV.UK. (2015). Import and export licences. Available from:

<https://www.gov.uk/guidance/export-and-import-licences-for-controlled-goods-and-trading-with-certain-countries> (viewed 14 July 2016)

Hosey, G., Melfi, V., & Pankhurst, S.(2009). Zoo Management: behaviour, management, and welfare. United Kingdom, Oxford University Press.

IUCN Red List. (2017). *Ursus maritimus*. Available from

<http://www.iucnredlist.org/details/22823/0> [viewed 16 March 2017]

Kenny, D. & Bickel, C. (2005). Growth and development of polar bear (*Ursus maritimus*) cubs at Denver Zoological Gardens. *International Zoo Yearbook*, 39(1): 205-214

Live Science. (2014). Polar Bear Facts. Available from

<http://www.livescience.com/27436-polar-bear-facts.html> [viewed 20 July 2016]

Maryland Zoo. (2017). Polar Bear Denning. Available from:

<http://www.marylandzoo.org/2015/10/polar-bear-denning/> [viewed 16 March 2017]

Mazuri Exotic Animal Nutrition. (2016). Polar Bear Diet #5590-40 lb. Available from

<http://www.mazuri.com/mazuripolarbeardiet.aspx> [viewed 21 July 2016]

NOAA Fisheries. (2015). FAQs on Morbillivirus and the Atlantic UME. Available from:

http://www.nmfs.noaa.gov/pr/health/mmume/faqs_morbillivirus_um_e.html
[viewed 26 July 2016]

PBPA (Polar Bear Protection Act) (2002). Polar Bear Protection Act, C.C.S.M. c. p.94

Pet Network Incline Vets. (2013). Myths Surrounding Heartworm Disease in Dogs. Available from <https://petnetworkinclinevets.wordpress.com/2013/03/19/myths-surrounding-heartworm-disease-in-dogs/> [viewed 22 July 2017]

Peter Marijnissen. (2016). Polar Bears Turn Out To Be Nicky and Simone. Available from: <http://petermarijnissen.nl/?cat=5> [viewed 22 July 2017]

Polar Bears International. (2016) Polar Bear FAQs. Available from <http://www.polarbearsinternational.org/about-polar-bears/faqs#q9> [viewed 19 July 2016]

Polar Bears International. (2016). Bathing and Cleaning. Available from: <http://www.polarbearsinternational.org/about-polar-bears/essentials/bathing-and-cleaning> [viewed 3 December 2016]

Polar Bears International. (2016). Hunting and Diet. Available from <http://www.polarbearsinternational.org/about-polar-bears/essentials/hunting-and-eating> [viewed 19 July 2016]

Polar Bears International. (2016). Sleeping and Bedding. Available from: <http://www.polarbearsinternational.org/about-polar-bears/essentials/sleeping-and-bedding> [viewed 3 December 2016]

Polar Bears International. (2017). Could polar bears learn to hunt like grizzlies?. Available from <https://polarbearsinternational.org/research/research-qa/could-polar-bears-learn-to-hunt-like-grizzlies/> [viewed 18 July 2017]

SammySee. (2017). The Polar Bear-Sammy See. Available from: <http://sammysee.weebly.com/reproductive-system.html> [viewed 16 March 2017]

Science 20. (2014). Causes, effects and Management of 'Blue Green Algae' Cyanobacteria and their Harmful Algal Blooms in Australian Recreation and Drinking Water with Two Ballina NSW Case Studies. Available from: <http://www.science20.com/causes-effects-and-management-of-blue-green-algae-cyanobacteria-and-their-harmful-algal-blooms-in-australian-water-139030> [viewed 22 July 2017]

SeaWorld Parks & Entertainment. (2017). Polar Bears: Behaviour. Available from: <https://seaworld.org/en/animal-info/animal-infobooks/polar-bears/behavior> [viewed 4 July 2017]

SeaWorld Parks & Entertainment. (2017). Polar Bears: Physical Characteristics. Available from: <https://seaworld.org/en/animal-info/animal-infobooks/polar-bears/physical-characteristics> [viewed 1 July 2017]

- SeaWorld Parks & Entertainment. (2017). Polar Bears: *Reproduction*. Available from: <https://seaworld.org/Animal-Info/Animal-InfoBooks/Polar-Bears/Reproduction> [viewed 22 July 2017]
- The Center for Food Security & Public Health. (2013). Baylisascariasis. Available from: <http://www.cfsph.iastate.edu/Factsheets/pdfs/baylisascariasis.pdf> [viewed 25 July 2016]
- Trichinella. (2004). Life cycle of *Trichinella spiralis*. Available from: http://www.trichinella.org/bio_lifecycle.htm [viewed 22 July 2017]
- Tryland, M. Derocher, AE. Wiig, Y., & Godfroid, J. (2001). Brucella sp. Antibodies in polar bears from Svalbard and the Barents Sea. *J Wildl Dis.* vol. 37 (3), p523-531
- Vennngage. (2017). The Polar Bear. Available from: <https://infograph.venngage.com/p/109768/polar-bear> [viewed 22 July 2017]
- Veterian Key. (2016). Salmon Poisoning Disease. Available from: <https://veteriankey.com/salmon-poisoning-disease/> [viewed 22 July 2017]
- Wide Open Spaces. (2016). Pennsylvania game commission trying to trap sickly-looking bear. Available from: <http://www.wideopenspaces.com/pennsylvania-game-commission-trying-to-trap-sickly-looking-bear-pics/> [viewed 22 July 2017]
- Wildlife Track. (2004). Immobilization and Animal Welfare. Available from: <http://wildtrack.org/learn-more-2/the-welfare-impacts-of-immobilization/> (viewed 27 June 2016)
- Wildpro. (2017). Hand-rearing Polar Bears: Diseases investigation & Management Treatment and Care. Available from http://wildpro.twycrosszoo.org/S/00Man/MammalHusbandryTechniques/Indiv_Techniques/HR_PolarBear.htm [viewed 18 July 2017]
- Wildpro. (2017). *Ursus maritimus* – Polar Bear. Available from: http://wildpro.twycrosszoo.org/S/0MCarnivor/ursidae/ursus/Ursus_maritimus/Ursus_maritimus.htm [viewed 16 March 2017]
- Wildpro. Arthritis and Skleteal Disease in Bears. Available from: http://wildpro.twycrosszoo.org/S/00dis/Miscellaneous/Arthritis_Bears.htm [viewed 26 July 2016]
- Wildpro. Audycoptic Mange in Bears. Available from http://wildpro.twycrosszoo.org/S/00dis/Parasitic/Audycoptic_mange_bears.htm [viewed 23 July 2016]
- Wildpro. Cestode Infections in Bears. Available from: http://wildpro.twycrosszoo.org/S/00dis/Parasitic/Cestodes_Bears.htm [viewed 26 July 2016]
- Wildpro. Dermatophilosis in Bears and Lagomorphs. Available from: http://wildpro.twycrosszoo.org/S/00dis/Bacterial/Dermatophilosis_Bears.htm [viewed 26 July 2016]

Wildpro. Gastritis in Bears. Available from:

http://wildpro.twycrosszoo.org/S/00dis/Miscellaneous/Gastritis_Bears.htm

[viewed 26 July 2016]

Wildpro. Hepatic and Bile Duct Neoplasia in Bears. Available from:

http://wildpro.twycrosszoo.org/S/00dis/Miscellaneous/Hepatic_neoplasia_Bears.htm

[viewed 26 July 2016]

Wildpro. Hookworm Infection in Bears. Available from:

http://wildpro.twycrosszoo.org/S/00dis/Parasitic/Hookworm_Bears.htm

[viewed 26 July 2016]

Wildpro. Salmon Poisoning in Bears. Available from

<http://wildpro.twycrosszoo.org/S/00dis/Bacterial/SalmonPoisoningBears.htm>

[viewed 21 July 2016]

WWF. (2017). Threats to polar bears. Available from:

http://wwf.panda.org/what_we_do/where_we_work/arctic/wildlife/polar_bear/threats/

[viewed 22 July 2017]

Zutrition. (2013). Polar Bear Nutrition Guide. Available from:

<http://www.zutrition.com/polar-bear-nutrition-guide/>

[viewed 22 July 2016]

Zutrition. (2013). Polar Bear Nutritional Disorders. Available from

<http://www.zutrition.com/polar-bear-nutritional-disorders/>

[viewed 23 July 2016]

Zutrition. (2016). Polar Bear Hand Rearing. Available from: <http://www.zutrition.com/polar-bear-hand-rearing/>

[viewed 22 July 2017]

14. Bibliography

Daily Mail Australia. (2014). I'm bearing up nicely! After a 12-hour journey, Victor, England's only polar bear, chills out in his new home. Available from:

<http://www.dailymail.co.uk/news/article-2727861/It-s-long-way-t-Arctic-Britain-s-polar-bear-Victor-arrives-new-home-Yorkshire.html>

[viewed 22 July 2017]

Polar Bears International. (2017). Zoos and Aquariums. Available from:

<http://polarbearsinternational.org/polar-bears/zoos-aquariums/>

[viewed 22 July 2017]

Rogers, L. (1985). Aiding the Wild Survival of Orphaned Bear Cubs. *Wildlife Rehabilitation* 4: 104-111

Snopek, R. (2013). *Hearts in the Wild: Inspiring Stories of Animal Rescues*. Heritage House Publishing Company Ltd, Toronto, Canada

15. Glossary

Cessation: The fact or process of ending or being brought to an end.

Cubing Den: An area separated from other management areas where pregnant females are denned up for cubing (AZA Bear TAG, 2009).

Den: Off-exhibit management area, where individuals can be separated for feeding, veterinary procedures, etc (AZA bear TAG, 2009).

Exhibit area: “Area of the *ex situ* habitat where a polar bear may be viewed by the public and is considered the bears’ primary living space” (9PBPA, 2002); can be indoor and/or outdoor (AZA Bear TAG, 2009).

Handeable: Animals with the ability/capabilities to handle objects.

Hyperplasia: When an organ or tissue becomes enlarged due to an increase in the reproduction rate of cells.

Necropsy: another term or way to describe carrying out an autopsy on an animal.

Off-Exhibit area: An area of the *ex situ* habitat where public viewing areas, individual animal dens, and cubing dens.

16. Appendix A: tables

CONTAINER REQUIREMENT 72

The illustrations shown in this Container Requirement are examples only. Containers that conform to the principle of written guidelines for the species but look slightly different will still meet the IATA standards.

Applicable to:

Bear species	Lion species
Binturong	Panther species
Cheehah	Puma species
Jaguar	Tasmanian devil
Leopard species	Tiger

Note:
The above species must be provided with space to lie comfortably but not turn around, except for bear species and binturong which must have space to turn around. There must be at least a 10 cm (4 in) clearance around the animal when standing in a normal position.

Note:
Should a veterinary certificate be provided stating that the large cat being shipped is suitable to be transported in a container which permits it to turn around, that container may be accepted for shipment.

STATE VARIATIONS: GBO-01/02/03/04, USG. Variations
OPERATOR VARIATIONS: CO-04/05/09, QF-01, SV-01

1. CONTAINER CONSTRUCTION

Materials
Hardwood, metal, 1.3 cm minimum (1/2 in) plywood or similar material, welded mesh, iron bars.

Principles of Design
The following principles of design must be met in addition to the General Container Requirements outlined at the beginning of this chapter.

Dimension
The height of the container must allow the animal to stand erect with its head extended and the length must permit it to lie in the prone position. The measurements will vary with the species involved.

Frame
The frame must be made from solid wood or metal tubing or screwed together. The frame must provide the spacer bar requirement of 2.5 cm (1 in) depth to the sides for air circulation. When the weight of the container plus animal exceeds 60 kg (132 lb), or the animal is very aggressive the frame must have additional metal reinforcing braces.

Sides
Suitable plywood or similar material must line the frame to give a smooth and strong interior.

EXAMPLE

Labels in the diagram include: Entry/exit sliding door (horizontal or vertical), Ventilation openings (top and bottom), Ventilation openings with light shields, Rubber, Space for fork-lift extrusion, Droppings tray, Narrow slatted floor for urine to pass through, Removable food and water container with outside filter at one end, Steel-welded mesh or iron bars (mesh 7.5 cm (3 in)), Shutter with ventilation openings, and Ventilation openings.

FIGURE 22. CONTAINER REQUIREMENTS. SOURCE: AZA BEAR TAG, 2009

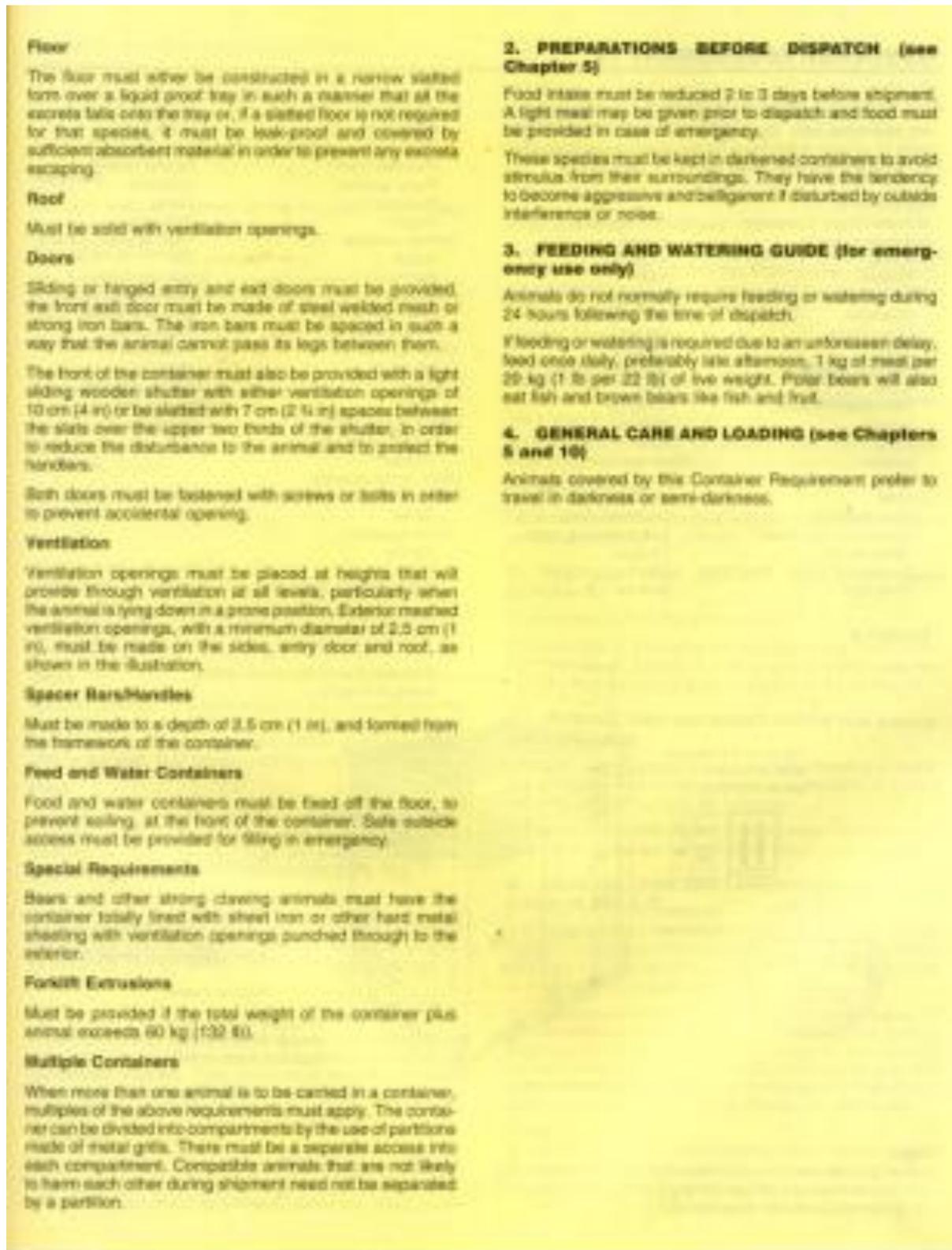


FIGURE 23. CONTAINER REQUIREMENTS. SOURCE: AZA BEAR TAG, 2009

San Francisco. Raised 1 bear from 1 day of age in 1982-1983

Day 1-5 1:3 Esbilac: water by volume

Item	Amount/100g (g)
Esbilac powder	11.6
Boiled water	88.4
Liquid pediatric vitamins	0.5 ml
Karo Syrup	4 ml

Beginning day 4 added cod liver oil at 5 ml/day

Day 6-7 Esbilac 1:2.5 water by volume

Item	Amount/100g (g)
Esbilac powder	14.0
Boiled water	86.0
Liquid pediatric vitamins	0.5 ml
Karo Syrup	4 ml

Added cod liver oil at 5 ml/day

Day 8-14 1:2 Esbilac: water by volume

Item	Amount/100g (g)
Esbilac powder	16.4
Boiled water	83.6
Liquid pediatric vitamins	0.5 ml
Karo Syrup	4 ml

Added cod liver oil at 5 ml/day

Day 15-28 1:1.5 Esbilac:water by volume

Item	Amount/100g (g)
Esbilac powder	20.8
Boiled water	80.3
Liquid pediatric vitamins	0.5 ml
Karo Syrup	4 ml

Added cod liver oil at 5 ml/day

Day 29+ 1:1 Esbilac:water by volume

Item	Amount/100g (g)
Esbilac powder	28.2
Boiled water	71.8
Liquid pediatric vitamins	0.5 ml
Karo Syrup	4 ml
Neo-Calglucon	2.5 ml

Added cod liver oil at 7.5 ml/day (increased to 10 ml/day Day 58)

FIGURE 24. 1 CUB RAISED IN SAN FRANCISCO FROM 1 DAY OF AGE IN 1982-1983. SOURCE: AZA BEAR TAG, 2009

Brookfield Zoo. Raised 1 bear from 5 days of age in 1999-2000

Brookfield Zoo's cub had a host of medical issues in the first weeks of life including a high white count, thrush (possibly antibiotic induced) and dehydration. The formulas listed below are what were actually used for this cub and may not all be appropriate for a healthy cub. Final formula is presumed to be appropriate for a healthy cub, but has not been tested.

Formula 1 day 5-7

Item	Amount/100g (g)
Esbilac powder	7.5
Multi-milk powder	7.5
Boiled water	85
Liquid pediatric vitamins (Poly-vi-sol)	1 drop
Liquid iron supplement (Fer-in-sol)	1 drop
Lactaid	3 drops

Formula 2 Day 8-17*

Item	Amount/100g (g)
Esbilac powder	15
Multi-milk powder	15
Boiled water	70
Liquid pediatric vitamins (Poly-vi-sol)	1 drop
Liquid iron supplement (Fer-in-sol)	1 drop
Lactaid	3 drops

*Hydration issues and illness required dilutions or combinations with Formula 1 until Day 14.

Formula 3 Day 18-24

Item	Amount/100g (g)
Esbilac powder	14.63
Multi-milk powder	7.32
Boiled water	75.61
Safflower oil	2.44
Liquid pediatric vitamins (Poly-vi-sol)	1 drop
Liquid iron supplement (Fer-in-sol)	1 drop
Lactaid	3 drops

Final formula used: Day 25 +

Item	Amount/100g (g)
Esbilac powder	11.26
Multi-milk powder	5.63
Boiled water	81.23
Safflower oil	1.88
Liquid pediatric vitamins (Poly-vi-sol)	1 drop
Liquid iron supplement (Fer-in-sol)	1 drop
Lactaid	3 drops

FIGURE 25. 1 CUB RAISED AT BROOKFIELD ZOO FROM 5 DAYS OF AGE IN 1999-2000 WHO HAD A NUMBER OF MEDICAL ISSUES IN THE FIRST FEW WEEKS AFTER BIRTH. SOURCE: AZA BEAR TAG, 2009

San Diego Zoo. Raised 2 bears from approximately 90 days of age in 2001

Day 90-100

Ingredients	Amount g/100 g
Esbilac Powder	11.5
Enfamil Powder	11.5
Corn Oil	4
Water	73

Day 101-222

Ingredients	Amount g/100 g
Esbilac Powder	13.5
Enfamil Powder	13.5
Corn Oil	4
Water	69

Day 223-343

Ingredients	Amount g/100 g
Esbilac Powder	14.5
Enfamil Powder	14.5
Corn Oil	2
Water	69

FIGURE 26. 2 CUBS RAISED IN SAN DIEGO ZOO FROM APPROXIMATELY 90 DAYS OF AGE IN 2001. SOURCE: AZA BEAR TAG, 2009